Online Supplement to "A Perioperative Intervention to Prevent and Treat Emergence Delirium at a Veteran Affairs Medical Center"
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This supplementary material was provided by the authors to give readers additional information and resources to replicate their work.

Supplemental Materials S1–S15
Materials Supporting the Intervention to Prevent and Treat Emergence Delirium

Supplemental Material S1
Essentials of the Intervention

How material is used: Clinical reference

Purpose: Identifies information integral to the safe and effective use of the intervention. This can be used as a handout during staff training

<table>
<tr><td>Essentials of the Intervention</td></tr>
</table>

Clinical Components and Phases

- The intervention consisted of 21 clinical components that were used across six phases, beginning with the *patient evaluation with individualized plan* phase and ending with the *actions following an episode of emergence delirium* phase.
- For a list of the 21 clinical components by phase, see supplemental material **S2**. The **S2** material identifies additional supplemental materials corresponding with the intervention and training of staff.

PAASO Form: Preoperative Anesthesia Assessment, Medication Strategy, and Outcome

- See supplemental material **S3.**
- Objectives for use of the form: identify (screen) patients who are at an elevated risk for emergence delirium, gather information to orient the patient upon emergence, facilitate patient hand-offs between staff, guide and document the medication strategy, and facilitate collection of information for the patient's record. Additionally, the form can be used to improve the continuity of care, track and trend the intervention integrity (i.e., implementation integrity) across staff, and monitor the overall effectiveness of intervention.
- Without routine screening for risk factors, anesthesia providers may not adjust their individualized anesthesia care plan to account for the patient's risk status and this may create an elevated risk of emergence delirium and patient/staff harm.

Communication Between Staff

- Communication is important to the success of the intervention and is used in each of the phases identified in supplemental material **S2**.
- Most of the communication between staff related to the intervention occurs during transitions from one phase to another and during a response to emergence delirium.
- Make sure that all staff within the chain of care of the patient are informed of pertinent information regarding risk for ED, potential triggers, patient's preferred waking method, and any other information that may help orient the patient during emergence.

Adjust Environment

- Create a low stimulation environment for the patient by placing them in a lower traffic area (e.g., private bay), dimming the lights, reducing noise, and consolidating/limiting unnecessary staff interactions (e.g., avoid interactions with trainees).
- Reduce the risk of patient harm by adjusting the table or bed (e.g., reduce height to increase leverage, lock wheels, pad side rails, secure arm boards and /or stirrups) and secure the intravenous (IV) site (e.g., extra tape and gauze).

Medication Strategy for Patients at Elevated Risk for Emergence Delirium

- See supplemental material **S5** for details about the medication strategy (e.g., sequence, dose, rate) and see supplemental material **S6** for a literature review in support of the medication strategy.
- Based on previous studies of emergence delirium, we recommend avoidance of midazolam and volatile anesthetics, and, as an alternative, administration of propofol, dexmedetomidine, and ketamine.
- Although midazolam is a universally administered preop anxiolytic, it is also a risk factor for emergence delirium, which is why it is absent from this medication strategy.
- Dexmedetomidine, if not otherwise contraindicated for cardiac impairment, is an excellent alternative to midazolam.
- To lessen the likelihood of emergence delirium, we advocate for administration of ketamine under the following conditions: 1) given at induction, pre-incision, and/or post-incision; 2) at a low or "analgesic" dose of <0.5 mg/kg, and 3) paired with an active anesthetic agent (e.g., propofol, volatile agent) and/or an active sedative adjunct (e.g., dexmedetomidine). Additionally, we recommend no more than 50 mg IV maximum for ketamine. Finally, we do not recommend administering ketamine preemergence (late in the case), as this may increase the likelihood of emergence delirium.
- We recommend treating **low-to-moderate-risk behavior** (e.g., inconsolable, disinhibited, restless, anxious, hallucinating) with **dexmedetomidine**.
- We recommend treating **moderate-to-high-risk behavior** (aggressive, angry, agitated, thrashing, kicking, attempting to exit bed, and other dangerous behavior) with **propofol**.

Patient Orientation Upon Emergence

- Mention familiar people and places. E.g., patient's name and nickname, names of immediate family members, pet's name, and location.
- Use patient's preferred physical interactions during emergence. E.g., tap on right shoulder and do not touch legs. Many staff have reported that patients will often express concern about being startled and not wanting to hurt anyone.
- Choose staff gender for the nursing care team consistent with the patient's preference. Some patients may have a history of sexual abuse/trauma and may have a strong gender preference of staff on the nursing care team. For example, a patient who has a history of sexual assault by a male perpetrator may prefer a female nursing team.
- Speaking in a softer tone of voice may help when assisting a patient during the emergence and reorientation process.

Actions in Response to an Episode of Emergence Delirium

- Call "Anesthesia stat" for additional support.
- Monitor for medical complications and use caution related to the surgical site.
- Monitor and protect IV site and airway.
- Administer medication, if necessary, to help manage patient behavior. See supplemental material **S5**.
- Manual (hands-on) restraint, if necessary
  - The purpose of manual restraint is to prevent the patient, who is engaging in dangerous behavior, from harming themselves and staff.
  - Manual restraint refers to staff placing their hands directly on the patient to secure a limb or area of the body. As a part of this intervention, staff must use specific techniques taught by experts through the lecture and hands-on (i.e., guided practice and simulation) training.
    - Techniques that may have been learned elsewhere are not permitted and are deemed unsafe.
    - Note that mechanical restraint, such as belts, straps, and cuffs, are different from manual restraint techniques.
    - Restraints are clinical interventions and therefore must be authorized by the appropriate level of clinical staff.
  - A minimum of four staff should be involved in managing and treating patient behavior. Work as a team; no one person should be responsible for manually restraining a patient. There must be an observer (a medically trained staff member who is not physically participating in the restraint) present to assess the safety of the patient and alert the responding team to any safety issue or medical distress occurring with the patient.
  - The manual restraint techniques focus on management of the patients' arms, legs, head, oxygen apparatus, and IV location. This section is not intended to be a "how-to" restraint application guide.
    - Arms – Pressure will be applied to the shoulder area and below the elbow (forearm) of both arms. At no time should pressure be applied to the elbow joint. The arms will remain in line with the body and will not be manipulated in a way that produces pain to force compliance. The arms will not be maneuvered away from the body or exceed the patient's natural range of motion.
    - Legs – Pressure will be applied to the thighs and shin areas. The legs can typically support pressure that is placed above or below the knees, but not directly on the knees.
    - Head – It may be necessary to support the head of the patient in a way that will prevent the patient from removing or dislodging the oxygen apparatus. Pressure may be placed on the patient's forehead and under the chin, but at no time should weight be applied to the neck (i.e., do not use a choke hold).
    - IV site – The area around the IV site will need to be secured to prevent IV removal. This will be accomplished by cupping a hand over the IV site to prevent dislodgment.
    - General guidelines –Please note that learners may have difficulty gauging the difference between adequate and excessive force when restraining a patient; therefore, this topic should be emphasized during training.
  - Patient positions
    - Recommended
      - Supine
      - Side – patients who are pregnant or obese
      - Standing escort technique – apply only if patient exits the table or bed
    - Not recommended
      - Prone
  - Risks with manual restraint
    - Positional asphyxiation – To prevent asphyxiation, weight should never be applied to the patients' thoracic cavity/abdominal area, lower/upper back, or neck area. Do not lie across the patient's upper body, which may restrict the patient's respiration.
    - Aspiration – The risk of aspiration should be low due to patient's nothing by mouth (NPO) status, but if the patient does aspirate during restraint, medical intervention must take priority over the restraint in order to clear the airway and ensure the safety of the patient.

- Orthopedic injuries – Do not exceed the patient's range of motion and do not use joint lock or pain compliance techniques.
- Skin integrity – Apply a measured amount of force during restraint and do not default to full force.

Actions Following an Episode of Emergence Delirium

- Debrief meeting with patient and family
  - Helping the patient process the experience is important. The concern is that patients who experience emergence delirium may be less likely to schedule a future procedure, which may have a long-term negative impact on their health (e.g., delayed diagnosis, treatment, and/or therapy).
  - Provide the patient with a prepared document explaining emergence delirium.
  - Prior to discharge provide the patient with a referral or contact information to a mental health service.
- Debrief meeting among staff
  - Discuss alternative explanations for the delirium.
  - Do we know what triggered the episode?
  - Could the episode have been prevented?
  - Discuss team response and what should be improved.
- Documentation
  - File an event report with the patient safety office or risk management.
  - Add a detailed note to the patient's record.

Supplemental Material S2
Clinical Components of the Perioperative Intervention to Prevent and Treat Emergence Delirium

How material is used: Clinical reference
Purpose: This table outlines the use of 21 clinical components across six phases, beginning with the *patient evaluation with individualized plan* phase and ending with the *actions following an episode of emergence delirium* phase

Phases	Clinical Components	Supplemental Material

Patient evaluation with individualized plan	1. Use the PAASO Form to conduct a preoperative anesthesia assessment
	   A. Review patient's record and interview patient to assess (screen) for emergence delirium (ED) risk factors
	   B. Meet with the high-risk patient and family to gather information to facilitate wake-up
	2. Communication; call ahead to procedure room to initiate intervention protocol
		◀S1–S3, S9
		
		◀S1, S2, S9

Preoperative actions	3. Communication; patient wears a unique colored surgical cap and bracelet to help staff recognize them as high-risk for ED
	4. Adjust environment
	   A. Low stimulation
	   B. Prepare equipment/apparatuses to mitigate risk in the event of dangerous behavior
	5. Follow medication strategy and document in the PAASO form
	6. Communication during time-out
	   A. Remind staff of patient's high-risk for ED
	   B. Inform staff of IV location and type of airway (e.g., O2 mask, endotracheal tube)
		◀S1, S2, S9
		
		◀S1, S2, S9
		
		◀S1-S6, S9
		◀S1, S2, S9

Intraoperative actions	7. Follow medication strategy and document in the PAASO form 8. Communication; as case concludes, call the recovery room/post-anesthesia care unit to initiate intervention protocol	◀S1-S6, S9 ◀S1, S2, S9

Postoperative actions	9. Adjust environment
	   A. Low stimulation
	   B. Prepare equipment/apparatuses to mitigate risk in the event of dangerous behavior
	10. Communication; consider proactively requesting additional staff due to anticipated risk for ED
	11. Staff should be prepared to protect IV access and maintain the airway
	12. Follow medication strategy and document on the PAASO form
	13. Use the PAASO form to document the patient's outcome and note in patient's record
		◀S1, S2, S9
		
		◀S1, S2, S9
		
		◀S1, S2, S9, S10, S12, S13, S15
		
		◀S1–S6, S9
		◀S1–S3, S9

Actions in response to an episode of emergence delirium	14. Communication; if needed, call for immediate staff support by using a standardized code (e.g., "Anesthesia stat") 15. If needed, staff should apply manual restraint (hands-on) to the patient to mitigate risk of harm to the patient and staff (note: special training and technique are required to ensure safety) 16. If needed, follow medication strategy 17. Attempt to orient the patient by stating familiar people and places (e.g., patient name, partner name, location of hospital)	◀ S1, S2, S9, S10, S13, S15 ◀S1, S2, S9-S15 ◀S1, S2, S4–S6, S9, S10, S13, S15 ◀S1–S3, S9, S11, S13–S15
Actions following an episode of emergence delirium	18. Debrief meeting with patient and family, which includes providing them with a prepared brochure about emergence delirium and a referral to behavioral health, if desired 19. Debrief meeting among staff to discuss alternative explanations for the ED and the effectiveness of their intervention 20. If applicable, in the PAASO form document any medications administered in response to emergence delirium 21. If applicable, file an event report with the patient safety office or risk management, and add a detailed note to the patient's record	◀S1, S2, S9 ◀S1, S2, S9 ◀S1–S3, S9 ◀S1–S3, S9

Note: The supplemental materials consist of information that either directly pertains to staff skill development (training or clinical reference) or are a tool integral to the clinical component.

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Supplemental Material S3
PAASO Form: Preoperative Anesthesia Assessment, Medication Strategy, and Outcome

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How material is used: Clinical documentation
Purpose: The form will be used to facilitate identification of patients who are at an elevated risk for emergence delirium, gather information to orient the patient upon emergence, facilitate hand-offs, guide and document the medication strategy, facilitate collecting information for patient record, and monitor effectiveness of the intervention across providers

<div align="center">

PAASO Form (v 6/17/2022)
Preoperative Anesthesia Assessment, Medication Strategy, and Outcome

</div>

	Date: **Procedure:**
	Anesthesia Plan (circle as applies)**:** *Local* *MAC* *General* *Regional*
[Patient Sticker]	**History of Difficult Airway** (circle one)? *No* *Yes*, describe:
	Allergies (circle one)? *NKDA* *Yes*, describe:
	ASA Status (circle one)**:** *I* *II* *III* *IV* *V* *(E)*

Part 1: Preoperative Anesthesia Assessment	**Staff who complete part 1**: Anesthesia provider **Purpose**: Identify patients who are at elevated risk for emergence delirium, further refine the medication strategy, gather information to orient the patient upon emergence, and facilitate hand-offs

1.1. Based on chart review and patient interview, is there a history of the following symptoms, conditions, or experiences (potential risk factors for emergence delirium)?

- ☐ **NONE**
- ☐ Previous occurrence of emergence delirium (confusion, anger, thrashing, flashbacks, hallucinations, screaming or hurt yourself or hurt someone else)
- ☐ Post-traumatic stress disorder (PTSD)
- ☐ Hypervigilance
- ☐ Flashbacks
- ☐ Irritability
- ☐ Exaggerated startle response

- ☐ Depression
- ☐ Anxiety
- ☐ Nightmares
- ☐ Sleep or mood disorder
- ☐ Traumatic brain injury (TBI)
- ☐ Traumatic event (e.g., sexually assaulted, domestic violence, combat)
- ☐ Substance use
- ☐ Other:

1.2. Based on chart review and patient interview, what is _your estimate_ of the patient's risk for emergence delirium?
<div align="center">☐ *Low*   ☐ *Moderate*   ☐ *High*</div>

1.3. Based on chart review and patient interview, are there any current medications and/or substances used (drugs and alcohol) that may impact the effectiveness of analgesic or sedative agents?   ☐*No*   ☐*Yes*, list:

Questions to Facilitate Wake-Up

1.4A. At home, do you often wake up confused, angry or violent?

☐*No*   ☐*Yes*, list:

1.4B. Is there anything specific I should do or not do (*triggers*) to wake you up at the end of your procedure? E.g., Don't touch me, only touch your left shoulder, gender preference for nursing care team, etc.

☐*No*   ☐*Yes*, list:

1.4C. Are there any names that I can use to help orient you when you wake up? E.g., your nickname, family member, pet

Part 2: Medication Strategy	**Staff who complete part 2**: Anesthesia provider **Purpose**: Facilitate hand-offs and monitor the perioperative intervention across department providers

2.1. Medications administered during *pre-operation, induction, and/or maintenance of anesthesia phases*	□ Dexmedetomidine □ Fentanyl □ Hydromorphone □ Ketamine □ Acetaminophen	□ Propofol □ Remifentanil □ Midazolam □ Volatile agent □ Oral opiates
2.2. *Preemergence*	□ **NONE** □ Dexmedetomidine	□ Hydromorphone □ Propofol
2.3. If applicable, in *response to emergence delirium*	□ **NONE** □ Dexmedetomidine	□ Propofol □ Midazolam

Part 3: Outcome	**Staff who complete part 3**: Anesthesia provider or PACU nurse **Purpose**: Monitor effectiveness of the intervention across department providers and facilitate collecting information for patient record	
3.1. Was there an episode of emergence delirium? E.g., violence, thrashing, aggression, combativeness, screaming, hallucinating, attempting to exit bed/table, and/or attempting to remove medical apparatuses	□*No* □*Yes*	
<u>If yes emergence delirium (3.1):</u> **3.2A. Was the behavior dangerous?**	□*No* □*Yes*, describe:	
3.2B. Was anyone injured?	□*No* □*Yes*, describe:	
3.2C. What may have triggered the episode? E.g., loud sound, bright light, or tactile stimulus	Describe:	
Anesthesia Provider: **Date:** **PACU Nurse**:		

Instructions for Using PAASO Form (v 6/17/2022)
Preoperative Anesthesia Assessment, Medication Strategy, and Outcome

Part 1: Preoperative Anesthesia Assessment

Purpose: Identify patients who are at elevated risk for emergence delirium, further refine the medication strategy, gather information to orient the patient upon emergence, and facilitate hand-offs
Who completes part 1: Anesthesia provider

Questions from PAASO Form	How information will be utilized
1.1. Based on chart review and patient interview, is there a history of the following symptoms, conditions, or experiences (potential risk factors for emergence delirium)?	Identify factors that could be associated with an increased likelihood of emergence delirium
1.2. Based on chart review and patient interview, what is *your estimate* of the patient's risk for emergence delirium?	• Develop and prepare a team response, if warranted • Improve the continuity of care between providers and/or staff • Track and trend the intervention plan across department providers
1.3. Based on chart review and patient interview, are there any current medications and/or substances used (drugs and alcohol) that may impact the effectiveness of analgesic or sedative agents?	This information will be used to guide the *medication strategy and the amount of medication administered*
Questions to Facilitate Wake-Up 1.4A. At home, do you often wake up confused, angry or violent? 1.4B. Is there anything specific I should do or not do to wake you up at the end of your procedure? 1.4C. Are there any names that I can use to help orient you when you wake up?	• (Q 1.4A) Guide the **preemergence** medication strategy and the amount of medication administered. I.e., challenging behaviors may indicate a need for additional medications and/or a greater dose • (Qs 1.4A, 1.4B) Identify stimuli (triggers) that could be associated with an increased likelihood of emergence delirium • (Qs 1.4A, 1.4B, 1.4C) Develop and prepare a team response, in anticipation of emergence delirium

Part 2: Medication Strategy

Purpose: Facilitate hand-offs and monitor the perioperative intervention across department providers
Who completes part 2: Anesthesia provider

Questions from PAASO Form	How information will be utilized
2.1. Medications administered during *preoperation, induction, and/or maintenance of anesthesia phases*	• Improve the continuity of care between providers and/or staff • Track and trend the intervention plan across department providers
2.2. *Preemergence*	
2.3. If applicable, in *response to emergence delirium*	

Part 3: Outcome

Purpose: Monitor effectiveness of the intervention and facilitate collecting information for patient record
Who completes part 3: Anesthesia provider or PACU nurse

Questions from PAASO Form	How information will be utilized
3.1. Was there an episode of emergence delirium?	• Collect information that will be entered into patient record and will guide provider practice during future procedures with the same patient • Track and trend the intervention plan across department providers
If yes emergence delirium: 3.2A. *Was the behavior dangerous?* 3.2B. *Was anyone injured?* 3.2C. *What may have triggered the episode?*	• If emergence delirium is observed, this information will facilitate a debrief meeting among staff and could be used to develop a patient safety event report

Supplemental Material S4
Timeline of Anesthesia Activities and Perioperative Care

How material is used: Clinical reference

Purpose: This information is intended to help people better understand patient status and staff responsibilities across the perioperative phases. In particular, we anticipate that readers will find the following information useful: stages of anesthesia, risk of emergence delirium (ED), and medication strategies.

Phases	Patient Status and Staff Responsibilities for Intravenous (IV)/Monitored Sedation or General Anesthesia With or Without Regional Anesthesia
Preoperation Preparation Immediately prior to transfer to operating room	• **Stage of anesthesia**: None • **Duration**: 5–15 min • **Risk of emergence delirium**: None to low • **Commonly administered medications:** Midazolam (Versed), dexmedetomidine, and/or fentanyl • **Our medication strategy**: None or acetaminophen, dexmedetomidine, and/or an opioid (oral or IV), to reduce anxiety as needed. For more information about these medications, see supplemental materials **S5** and **S6.** • **Desired patient status**: Nonsedated or transitioning from conscious and communicative to lightly sedated, but remains voluntarily participative • **Staff responsibilities**: Transition patient from preoperative area to surgical or procedural suite. Move patient from stretcher to operating room bed. Alarms and monitors are applied and activated. Supplemental oxygen is administered, as required.
Induction of Anesthesia Administration of an agent to provide sedation or general anesthesia as necessary	• **Stage of anesthesia**: Transition from stage 1 to stage 2 • **Duration**: 2–5 min • **Risk of emergence delirium**: Low to moderate during transition through stage 2, which is the stage with greatest risk of ED. Duration of stage 2 is typically greater with IV/monitored sedation than general anesthesia. • **Commonly administered medications:** Midazolam, fentanyl, lidocaine, and propofol • **Our medication strategy**: Lidocaine, propofol, ketamine, and hydromorphone. For more information about these medications, see supplemental materials **S5** and **S6.** • **Desired patient status**: Transitioning to a state of amnesia and analgesia • **Staff responsibilities**: Support and maintain adequate vital signs; ventilatory support; and administer adjunct medications, as required, in preparation to achieve a surgical plane of anesthesia
Maintenance of Anesthesia Maintain desired level of anesthesia required for the procedure	• **Stage of anesthesia**: 3 • **Duration**: Dependent on procedure • **Risk of emergence delirium**: Low, depending on integrity of anesthesia delivery to maintain adequate depth of anesthesia • **Commonly administered medications:** Propofol infusion (total intravenous anesthesia) and/or volatile anesthetic (inhalational), depending on type of anesthesia • **Our medication strategy**: Propofol infusion with or without adjunct agents (e.g., dexmedetomidine, ketamine, hydromorphone), depending on type of anesthesia. For more information about these medications, see supplemental materials **S5** and **S6.** • **Desired patient status**: Unconscious; however, spontaneous respirations are preserved during IV/monitored sedation and respirations are often controlled during general anesthesia • **Staff responsibilities**: Continuously reassess vital signs and administer maintenance and adjunct medications to preserve the appropriate level of anesthesia

Emergence Patient awakens from anesthesia leading to the greatest potential for delirium or excitement	• **Stage of Anesthesia**: Transition from stage 3 to stage 2 to stage 1 • **Duration**: 5–20 min • **Risk of emergence delirium**: Moderate to high, relative to other perioperative phases • **Commonly administered medications:** Administration of midazolam and/or propofol, if a patient demonstrates emergence delirium • **Our medication strategy**: Preemergence administration of dexmedetomidine and/or hydromorphone, as a preemptive treatment for a patient who is at elevated risk for emergence delirium. If a patient demonstrates emergence delirium, then administer propofol. For more information about these medications, see supplemental materials **S5** and **S6.** • **Desired patient status**: Transitioning from semiconscious or unconscious to conscious and cooperative • **Staff responsibilities**: Maintain monitoring of vital signs; maintain/secure airway and IV; and assess/treat emergence delirium, as needed

Note*:* Stage 1 of anesthesia is commonly referred to as the induction stage. Patients are sedated but remain conscious and perhaps even conversational. Breathing is slow and regular. This stage progresses from analgesia with no amnesia, to analgesia with amnesia, and finally ends with the loss of consciousness.[18]

Stage 2 of anesthesia is referred to as the delirium or excitement stage. This stage is distinguished by disinhibition, delirium, uncontrolled movements, loss of eyelash reflex, hypertension, and tachycardia.[18] Airway reflexes remain intact during this phase and are often hypersensitive to stimulation and thus airway manipulation should be avoided. There is a higher risk of laryngospasm (involuntary closure of vocal cords) at this stage, which may be precipitated by any airway manipulation or another stimulus such as loud noises and conversation in the OR.[19] This stage is often where airway compromise occurs. Fast-acting agents help reduce the time spent in stage 2 as much as possible and facilitate entry to stage 3.

Stage 3 is a surgical plane of general anesthesia. Eye movements cease and respiratory depression occurs to various degrees.[18] Airway manipulation is safe at this stage.

Stage 4 is rarely seen and is an overdose state of anesthesia. This stage occurs when too much anesthetic agent is given relative to the amount of surgical stimulation, which may result in central respiratory paralysis, cardiac failure, and then death.[18]

References

18. Guedel AE. Anesthesia: A Teaching Outline. Stages of Anesthesia. *Anesth Analg*. 1936;15(1):1-4.

19. Nagelhout JJ, Elisha S, editors. *Nurse Anesthesia*. 6th ed. St. Louis, MO: Elsevier; 2018.

Supplemental Material S5
Medication Strategy for Patients at Elevated Risk for Emergence Delirium

How material is used: Clinical reference
Purpose: This medication strategy (individualized anesthesia care plan) was designed to improve the prevention and treatment of emergence delirium

Phases	Types of Anesthesia and Medications		

Preoperation Preparation Immediately prior to transfer to operating room	Sequence of Meds	Intravenous (IV)/Monitored Sedation With or Without Regional Anesthesia	General Anesthesia With or Without Regional Anesthesia
	1	**Acetaminophen**: 1000–1300 mg, oral	
	2	*Optional* **Dexmedetomidine**: 8–20 mcg (0.25–0.5 mcg/kg ideal body weight, titration to effect), IV	
	3	*Optional*, one of the following: • **Fentanyl**: 50–100 mcg, IV • **Hydromorphone**: 0.2–1.0 mg, IV (**Note**: not administered as a premedication with regional anesthesia) • **Oral Opioid**	

Note: With dexmedetomidine, the clinically effective onset of sedation occurs 5–10 minutes after bolus administration.

Induction of Anesthesia Administration of an agent to provide sedation or general anesthesia as necessary	Sequence of Meds	Intravenous (IV)/Monitored Sedation With or Without Regional Anesthesia	General Anesthesia With or Without Regional Anesthesia
	1	**Lidocaine**: 50–100 mg, IV	
	2	**Propofol**, *one or both* of the following: • **Bolus**: Incremental doses, 25–100 mg, IV • **Infusion**: 25–150 mcg/kg/min, IV	**Propofol**, *both* of the following: • **GETA**: 1.0–2.0 mg/kg, IV • **Infusion**: 50–150 mcg/kg/min, IV
	3	***Ketamine**: <0.5 mg/kg (low dose ketamine, maximum of 50 mg), IV	
	4	***Hydromorphone**: 0.2–1.0 mg, IV	

Note: *During most procedures we (VAPHS) recommend use of Ketamine and/or Hydromorphone as an analgesic.

Maintenance of Anesthesia Maintain desired level of anesthesia required for the procedure	Sequence of Meds	Intravenous (IV)/Monitored Sedation With or Without Regional Anesthesia	General Anesthesia With or Without Regional Anesthesia
	1	**Propofol infusion**: 25–150 mcg/kg/min, IV	
	2	**Dexmedetomidine**: • *Optional* **loading dose**: 0.5–1.0 mcg/kg, IV, over 10 minutes • **Infusion**: 0.2–1.0 mcg/kg/hour, IV	
	3	Not applicable	*Optional* **Remifentanil infusion**: 0.04-0.1mcg/kg/min, IV
	4	***Ketamine**: <0.5 mg/kg (low dose ketamine, maximum of 50 mg), IV	
	5	***Hydromorphone**: 0.2–2.0 mg, IV	

Note: A dexmedetomidine infusion alone can be used with a limited number of specific procedures (e.g., awake fiberoptic intubation) as an IV/monitored sedation. *During most procedures we (VAPHS) recommend use of ketamine and/or hydromorphone as an analgesic.

	Sequence of Meds	Intravenous (IV)/Monitored Sedation With or Without Regional Anesthesia	General Anesthesia With or Without Regional Anesthesia
Emergence- Patient awakens from anesthesia leading to the greatest potential for emergence delirium	1	**Preemergence, *bolus* or *infusion* of dexmedetomidine**: • **Bolus**: 8–20 mcg (0.25–0.5 mcg/kg ideal body weight, titration to effect), IV, repeat as needed • **Infusion**: 0.2–1.0 mcg/kg/hour, IV (**loading dose**: 0.5–1.0 mcg/kg, IV, over 10 minutes)	
	2	**Preemergence, hydromorphone bolus**: 0.2-1.0mg, IV, repeat as needed	
	3	**Preemergence, if not previously administered, acetaminophen infusion**: 1000 mg, IV, over 20 minutes	
	4	**Post-emergence, if patient demonstrates low-to-moderate-risk behavior, *bolus* or *infusion* of dexmedetomidine**: • **Bolus**: 8–20 mcg (0.25–0.5 mcg/kg ideal body weight, titration to effect), IV, repeat as needed • **Infusion**: 0.2–1.0 mcg/kg/hour, IV (**loading dose**: 0.5–1.0 mcg/kg, IV, over 10 minutes)	
	5	**Post-emergence, if patient demonstrates moderate-to-high-risk behavior, *bolus* or *infusion* of propofol**: • **Bolus**: 50–200 mg, IV, repeat as needed • **Infusion**: 50–150 mg/kg/min, IV	

Note: *We* (VAPHS) *do not recommend* administering ketamine pre-emergence (late in the case), as this may increase the likelihood of emergence delirium.

Warnings, Precautions, and Strategies	**General information** 1. Coadministration of anesthetic agents and/or adjuncts can enhance pharmacodynamics; therefore, caution must be taken to account for the additive impact on the patient's vital signs.[20] 2. Note that this medication strategy is only designed to prevent and/or treat emergence delirium. **Dexmedetomidine** 1. Clinically significant risks of using dexmedetomidine: severe bradycardia, sinus arrest, and hypotension.[20] 2. Not all patients are dexmedetomidine candidates. Patients who have a history of congestive heart failure, advanced heart blocks, bradyarrhythmias, and/or severe ventricular dysfunction should not receive dexmedetomidine.[20] Alternatively, a reduced administration plan for dexmedetomidine should also be anticipated for patients with one or more chronic and/or age-related medical conditions.[20] For example, elderly patients, diabetics, and those with expected or proven renal and/or hepatic impairment may not be ideal dexmedetomidine candidates. 3. Caution should be taken with patients who have a low resting heart rate and/or low blood pressure (e.g., young/healthy, athletes, soldiers, high vagal tone, and spinal cord injury patients).[20-23] With these patients, proactive strategies should be applied to prevent clinically significant risks. 4. Prior to administration of dexmedetomidine, staff should consider the following two proactive strategies to offset anticipated systemic effects on vital signs: a. Prehydrate, increase IV fluid administration (e.g., crystalloid) to compensate for an anticipated drop in systolic blood pressure.[24] b. The drug may require preemptive glycopyrrolate IV to elevate heart rate to a safe level. 5. Post-administration of dexmedetomidine, staff should consider the following four reactive strategies to offset systemic effects on vital signs: a. Decrease or discontinue infusion.[20] b. Increase IV fluid administration.[20] c. Elevate lower extremities.[20] d. Use of pressor agents (e.g., atropine, glycopyrrolate, ephedrine, and/or phenylephrine).[20] 6. Clinically effective onset of sedation occurs 5–10 minutes after IV bolus administration,[25] 10–15 minutes after IV infusion,[20] and the duration of action is approximately 2 hours.

References

20. Hospira Inc. *Dosing Guidelines for Precedex: Nonintubated Procedural Sedation and ICU Sedation*. Lake Forest, IL: Hospira Inc; 2009. p. 1-15.

21. Myers C. FDA Approves New Indication for Hospira's Precedex (Dexmedetomidine HCL) Injection. Fierce Biotech website. https://www.fiercebiotech.com/biotech/fda-approves-new-indication-for-hospira-s-precedex-dexmedetomidine-hcl-injection. Published October 31, 2008. Accessed May 12, 2022.

22. Hospira Inc. Precedex- Dexmedetomidine Hydrochloride Injection, Solution, Concentrate [package insert LAB-1346-3.0]. Pfizer labeling website. https://labeling.pfizer.com/ShowLabeling.aspx?id=4404. Revised August 2022. Accessed December 9, 2022.

23. Gerlach AT, Blais DM, Jones GM, Burcham PK, Stawicki SP, Cook CH, et al. Predictors of Dexmedetomidine-Associated Hypotension in Critically Ill Patients. *Int J Crit Illn Inj Sci*. 2016;6(3):109-14. Epub 2016/10/11. doi: 10.4103/2229-5151.190656. PubMed PMID: 27722111; PubMed Central PMCID: PMCPMC5051052.

24. Mason KP, Turner DP, Houle TT, Fontaine PJ, Lerman J. Hemodynamic Response to Fluid Management in Children Undergoing Dexmedetomidine Sedation for MRI. *AJR Am J Roentgenol*. 2014;202(6):W574-9. Epub 2014/05/23. doi: 10.2214/AJR.13.11580. PubMed PMID: 24848852.

25. Baughman V, Golembiewski J, Gonzalez J, Alvarez W, editors. *Anesthesiology & Critical Care Drug Handbook*. 10th ed. Hudson, OH: Lexi-Comp Inc; 2011.

Supplemental Material S6
Literature Review in Support of the Medication Strategy

How material is used: Clinical reference

Purpose: This information represents a literature review of anesthetics and adjunct agents that are associated with an increased or decreased likelihood of emergence delirium. This information was used to shape the medication strategy (individualized anesthesia care plan) described in supplemental materials **S4** and **S5.**

Midazolam (Benzodiazepine). Midazolam, an anxiolytic, amnestic benzodiazepine,[25] is perhaps the most universally administered sedative.[26,27] The clinical effects of midazolam occur as a result of agonist action on the binding sites on GABA$_A$ neurotransmitter receptors throughout the central nervous system.[28] Midazolam is often administered preoperatively to treat anxiety and is widely used due to its rapid onset of 2–5 minutes, 20–30 minute duration, and ability to be reversed.[25,29]

Despite widespread use of midazolam/benzodiazepines, several studies reported an association between administration of the medication and an increased likelihood of emergence delirium.[3,30-32] For example, one study found that preoperative use of benzodiazepines with patients >15 years of age was associated with nearly twice the risk of emergence delirium.[3] Similarly, in a prospective observational study of 1,868 adult patients, they reported that patients who were administered 0.1 mg/kg of midazolam as a premedication had a significantly greater incidence of emergence delirium than patients who did not receive midazolam.[30] Previous literature also suggests that patients with a history of post-traumatic stress disorder (PTSD) or trauma and who are administered midazolam are at a higher risk for emergence delirium.[6,33-35] There is some debate among providers about the relation between midazolam/benzodiazepines and emergence delirium;[13] nevertheless, in our opinion, the previous studies and other literature collectively indicate that anesthesia providers may reduce the likelihood of emergence delirium by avoiding administration of midazolam/benzodiazepines.

Dexmedetomidine. Dexmedetomidine, an alternative to midazolam,[25,36-41] is a sedative-analgesic (opioid-sparing) and a potent anxiolytic.[6,20,33,42-45] Dexmedetomidine is an agonist of the alpha-2 adrenergic receptor and acts by reducing the sympathetic noradrenergic outflow and inhibits the central release of norepinephrine, thereby attenuates the hyperarousal state and fight-or-flight response.[33,43-49] Dexmedetomidine, when administered prior to emergence (preoperatively, intraoperatively, and/or at the end of surgery), will facilitate cooperative and tranquil patient behavior.[33,36,38-41,43-47,49-56] Dexmedetomidine has an onset of 5–10 minutes and duration of 2–3 hours.[20,25]

Numerous studies have shown that dexmedetomidine is effective in preventing emergence delirium,[31,38-41,46,48-57] while few studies indicate that it may be used to treat an episode of emergence delirium.[35,58,59] One study showed that preoperative and intraoperative administration of dexmedetomidine significantly reduced the incidence and severity of emergence delirium among anxiety afflicted combat veterans.[46] In a randomized study of children undergoing surgery, administering 0.3 mcg/kg of dexmedetomidine 10 minutes after induction was associated with 27% less incidence of emergence delirium than the control group.[60] Overall, administration of dexmedetomidine is associated with a more cooperative patient and safer behavior throughout emergence.

Ketamine. Ketamine is a dissociative sedative-analgesic with opioid-sparing properties.[25,61,62] Ketamine is an antagonist of the N-methyl-D-aspartate (NDMA) receptor and modulates the presynaptic release of glutamate, which is the most abundant excitatory neurotransmitter in the central nervous system.[29,63,64] Inhibition of and reduction in available glutamate influences a decrease in the pathophysiologic response to stress, which is associated with a prevention of emergence delirium.[29,34,64] Timing of ketamine administration has varied widely across previous studies and included the following phases: preoperative, induction, and/or at the end of surgery (pre-emergence).[32,33,37,50,64-78] Ketamine has an onset of less than 1 minute and has a dose-dependent duration of 5–20 minutes.[25,29,79]

Previous research on ketamine has reported conflicting findings,[66] with some indicating that it increases the likelihood of emergence delirium[67,68,77] and others suggesting that it can reduce the likelihood.[31,32,37,50,69,73-75,78,80,81] Among the studies reporting an association between ketamine and an increased likelihood of emergence delirium, they administered ketamine under both of the following conditions: 1) administered a relatively higher dose (e.g., >0.5 mg/kg);[67,77] and 2) without an additional active anesthetic agent (e.g., propofol, volatile agent) or an active sedative adjunct (e.g., dexmedetomidine).[67,77] In contrast, in the studies that reported an association between use of ketamine and a decreased likelihood of emergence delirium, they administered ketamine under one or more of the following conditions: 1) administered a relatively low dose (e.g., <0.5 mg/kg);[74,75,78,81] and/or 2) paired with an active anesthetic agent (e.g., propofol, volatile agent) and/or an active sedative adjunct (e.g., dexmedetomidine).[37,69,73-75,78,80,81] For example, a double-blind study of pediatric cases with sevoflurane-based anesthesia found that patients who were administered 0.15 mg/kg of ketamine and 0.3 mcg/kg of dexmedetomidine, 10 minutes before the end of surgery, resulted in a significantly lower rate and severity of emergence delirium, relative to administration of saline (control condition).[81] Our review of literature indicates that when ketamine is administered as a low dose and/or when paired with an active anesthetic agent or sedative adjunct, there is a lower likelihood and severity of emergence delirium.

Volatile Anesthetics (Inhalational). Volatile anesthetics (e.g., desflurane, halothane, isoflurane, and sevoflurane) are inhaled and produce titration-dependent amnesia, unconsciousness, and immobility, but not analgesia.[28,29,82] Volatile anesthetics are used for the rapid induction and maintenance of general anesthesia. This type of drug acts on the GABA$_A$ receptor by suppressing the excitatory channels and augmenting the inhibitory channels.[28,29,82-84] Volatile anesthetics, depending on the type and concentration, have an uptake and onset of 1–4 minutes and the patient will emerge (eye opening) 10–15 minutes following discontinuation.[29,82]

Much of the previous research reported that the administration of volatile anesthetics is associated with a higher rate and/or severity of emergence delirium.[3,50,85-96] For example, a randomized clinical trial of 80 adults undergoing invasive nasal surgery compared the rates of emergence delirium between a patient group with volatile anesthetic induction/maintenance and another group with propofol/total intravenous anesthesia (TIVA).[92] They used two different agitation assessment scales (Richmond Agitation-Sedation Scale and Riker Sedation-Agitation Scale) and, across both scales, they found 20%–25% rates of agitation in the volatile anesthetic group and a rate of 2.5% in the propofol/TIVA group. Also, several studies of the effects of volatile anesthetics found that patients who had noninvasive procedures (e.g., MRI) and were without pain also experienced a high rate of emergence delirium.[86,97,98] As a whole, a large portion of the previous literature indicates that volatile anesthetics are associated with an increased risk and severity of emergence delirium.

Propofol/Total Intravenous Anesthesia (TIVA). Propofol is a sedative-hypnotic that is administered for the rapid induction and maintenance of anesthesia,[25] and can also be administered to rapidly treat an episode of emergence delirium.[99,100] Propofol, like volatile anesthetics, augments and extends the duration of $GABA_A$-mediated synaptic inhibition.[83,84] Propofol has an onset of less than 1 minute and a dose-dependent duration of 3–10 minutes.[25,28]

Several studies have shown that the administration of propofol, as a maintenance anesthetic and/or pre-emergence bolus, was associated with a lower rate and/or severity of emergence delirium.[3,31,50,85-92,101-105] For example, in two studies, each with >790 adult patients, the authors found that administration of propofol (i.e., TIVA) as a maintenance anesthetic was associated with a significantly reduced incidence of emergence delirium, when compared with patients who were administered a volatile anesthetic.[89,90] Unfortunately, few previous studies have systematically evaluated the use of propofol as an acute treatment during an episode of emergence delirium; nevertheless, providers have reported that propofol is an effective treatment for an episode of emergence delirium.[99,100]

Summary of Relation Between Medications and Emergence Delirium. Previous literature indicates that use of midazolam and/or volatile anesthetics are associated with an increase of the likelihood and severity of emergence delirium when compared with administration of alternative medications. As a result, we recommend and use a medication strategy that includes dexmedetomidine, ketamine, and propofol (TIVA), in an effort to reduce the likelihood and severity of emergence delirium among our high-risk patients.

References

3. Lepouse C, Lautner C, Liu L, Gomis P, Leon A. Emergence Delirium in Adults in the Post-Anaesthesia Care Unit. *Br J Anaesth*. 2006;96(6):747-53. doi: 10.1093/bja/ael094.

6. Tolly B, Waly A, Peterson G, Erbes CR, Prielipp RC, Apostolidou I. Adult Emergence Agitation: A Veteran-Focused Narrative Review. *Anesth Analg*. 2021;132(2):353-64.

13. Viswanath O, Kerner B, Jean Y-K, Soto R, Rosen G. Emergence Delirium: A Narrative Review. *J Anesthesiol Clin Sci*. 2015;4(2):e1-e8.

20. Hospira Inc. *Dosing Guidelines for Precedex: Nonintubated Procedural Sedation and ICU Sedation*. Lake Forest, IL: Hospira Inc; 2009. p. 1-15.

25. Baughman V, Golembiewski J, Gonzalez J, Alvarez W, editors. *Anesthesiology & Critical Care Drug Handbook*. 10th ed. Hudson, OH: Lexi-Comp Inc; 2011.

26. Deshmukh PV, Kulkarni SS, Parchandekar MK, Sikchi SP. Comparison of Preanesthetic Sedation in Pediatric Patients With Oral and Intranasal Midazolam. *J Anaesthesiol Clin Pharmacol*. 2016;32(3):353-8.

27. Bergendahl H, Lönnqvist P-A, Eksborg S. Clonidine: An Alternative to Benzodiazepines for Premedication in Children. *Curr Opin Anesthesiol*. 2005;18(6):608-13.

28. Butterworth J, Mackey D, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*. 5th ed. New York, NY: McGraw-Hill Education, LLC; 2013.

29. Stoelting RK, Miller RD. *Basics of Anesthesia*. 4th ed. Philadelphia, PA: Churchill Livingstone; 2000.

30. Radtke F, Franck M, Hagemann L, Seeling M, Wernecke K, Spies C. Risk Factors for Inadequate Emergence After Anesthesia: Emergence Delirium and Hypoactive Emergence. *Minerva Anestesiol*. 2010;76(6):394-403.

31. Wang W, Huang P, Gao W, Cao F, Yi M, Chen L, et al. Efficacy and Acceptability of Different Auxiliary Drugs in Pediatric Sevoflurane Anesthesia: A Network Meta-Analysis of Mixed Treatment Comparisons. *Sci Rep*. 2016;6(1):1-11. doi: 10.1038/srep36553.

32. Kim KM, Lee KH, Kim YH, Ko MJ, Jung J-W, Kang E. Comparison of Effects of Intravenous Midazolam and Ketamine on Emergence Agitation in Children: Randomized Controlled Trial. *J Int Med Res*. 2016;44(2):258-66. doi: 10.1177/0300060515621639.

33. Lovestrand D, Lovestrand S, Beaumont DM, Yost JG. Management of Emergence Delirium in Adult PTSD Patients: Recommendations for Practice. *J Perianesth Nurs*. 2017;32(4):356-66.

34. McLott J, Jurecic J, Hemphill L, Dunn KS. Development of an Amygdalocentric Neurocircuitry-Reactive Aggression Theoretical Model of Emergence Delirium in Posttraumatic Stress Disorder: An Integrative Literature Review. *AANA J*. 2013;81(5):379-84.

35. Greiner S, Kremer MJ. Clarifying the Confusion of Adult Emergence Delirium. *AANA J*. 2019;87(3):243-51.

36. Kurhekar P, Vinod K, Rajarathinam B, Krishna JSD, Raghuraman M. Randomized Comparison Between Dexmedetomidine and Midazolam for Prevention of Emergence Agitation After Nasal Surgeries. *Saudi J Anaesth*. 2018;12(1):61-6.

37. Levanen J, Makela M-L, Scheinin H. Dexmedetomidine Premedication Attenuates Ketamine-Induced Cardiostimulatory Effects and Postanesthetic Delirium. *Anesthesiology*. 1995;82(5):1117-25.

38. Kim JC, Kim J, Kwak H, Ahn SW. Premedication With Dexmedetomidine to Reduce Emergence Agitation: A Randomized Controlled Trial. *BMC Anesthesiol*. 2019;19(144):1-6.

39. Pasin L, Febres D, Testa V, Frati E, Borghi G, Landoni G, et al. Dexmedetomidine vs Midazolam as Preanesthetic Medication in Children: A Meta-Analysis of Randomized Controlled Trials. *Paediatr Anaesth*. 2015;25(5):468-76.

40. Rao Y, Zeng R, Jiang X, Li J, Wang X. The Effect of Dexmedetomidine on Emergence Agitation or Delirium in Children After Anesthesia—A Systematic Review and Meta-Analysis of Clinical Studies. *Front Pediatr*. 2020;8:1-19.

41. Sethi P, Mohammed S, Bhatia PK, Gupta N. Dexmedetomidine Versus Midazolam for Conscious Sedation in Endoscopic Retrograde Cholangiopancreatography: An Open-Label Randomised Controlled Trial. *Indian J Anaesth*. 2014;58(1):18-24.

42. Lovestrand D, Phipps PS, Lovestrand S. Posttraumatic Stress Disorder and Anesthesia Emergence. *AANA J*. 2013;81(3):199-203.

43. Mahmoud M, Mason K. Dexmedetomidine: Review, Update, and Future Considerations of Paediatric Perioperative and Periprocedural Applications and Limitations. *Br J Anaesth*. 2015;115(2):171-82.

44. Kaur M, Singh P. Current Role of Dexmedetomidine in Clinical Anesthesia and Intensive Care. *Anesth. : essays res*. 2011;5(2):128-33.

45. Wiatrowski R. Current State of Pain Treatment: Does Dexmedetomidine Have a Role to Play? *AANA J*. 2021;89(1):77-86.

46. Bartoszek M, McGuire JM, Wilson JT, Sorensen JS, Vice TF, Hudson AJ. The Effectiveness of Dexmedetomidine as a Prophylactic Treatment for Emergence Delirium Among Combat Veterans With High Anxiety: A Randomized Placebo-Controlled Trial. *Mil Med*. 2021;usab212:1-9.

47. Haselman MA. Dexmedetomidine: A Useful Adjunct to Consider in Some High-Risk Situations. *AANA J*. 2008;76(5):335-9.

48. Maldonado JR, Wysong A, Van Der Starre PJ, Block T, Miller C, Reitz BA. Dexmedetomidine and the Reduction of Postoperative Delirium After Cardiac Surgery. *Psychosomatics*. 2009;50(3):206-17.

49. Zhang J, Yu Y, Miao S, Liu L, Gan S, Kang X, et al. Effects of Peri-operative Intravenous Administration of Dexmedetomidine on Emergence Agitation After General Anesthesia in Adults: A Meta-analysis of Randomized Controlled Trials. *Drug Des Dev Ther*. 2019;13:2853-64. doi: 10.2147/DDDT.S207016.

50. Dahmani S, Stany I, Brasher C, Lejeune C, Bruneau B, Wood C, et al. Pharmacological Prevention of Sevoflurane-and Desflurane-Related Emergence Agitation in Children: A Meta-Analysis of Published Studies. *Br J Anaesth*. 2010;104(2):216-23.

51. Hauber JA, Davis PJ, Bendel LP, Martyn SV, McCarthy DL, Evans M-C, et al. Dexmedetomidine as a Rapid Bolus for Treatment and Prophylactic Prevention of Emergence Agitation in Anesthetized Children. *Anesth Analg*. 2015;121(5):1308-15.

52. Shukry M, Clyde MC, Kalarickal PL, Ramadhyani U. Does Dexmedetomidine Prevent Emergence Delirium in Children After Sevoflurane-Based General Anesthesia? *Paediatr Anaesth*. 2005;15(12):1098-104.

53. Nguyen S, Pak M, Paoli D, Neff DF. Emergence Delirium With Post-Traumatic Stress Disorder Among Military Veterans. *Curēus*. 2016;8(12):e921.

54. Sun M, Peng T, Sun Y, Huang Z, Jiang J, Wang C, et al. Intraoperative Use of Low-Dose Dexmedetomidine for the Prevention of Emergence Agitation Following General Anaesthesia in Elderly Patients: A Randomized Controlled Trial. *Aging Clin Exp Res*. 2022;34(3):611-8.

55. Ni J, Wei J, Yao Y, Jiang X, Luo L, Luo D. Effect of Dexmedetomidine on Preventing Postoperative Agitation in Children: A Meta-Analysis. *PLoS One*. 2015;10(5):e0128450.

56. Hu J, Zhu M, Gao Z, Zhao S, Feng X, Chen J, et al. Dexmedetomidine for Prevention of Postoperative Delirium in Older Adults Undergoing Oesophagectomy with Total Intravenous Anaesthesia: A Double-Blind, Randomised Clinical Trial. *Eur J Anaesthesiol*. 2021;38:S9-S17.

57. Lee HS, Yoon HY, Jin HJ, Hwang SH. Can Dexmedetomidine Influence Recovery Profiles From General Anesthesia in Nasal Surgery? *Otolaryngol Head Neck Surg*. 2018;158(1):43-53.

58. Read MD, Maani CV, Blackwell S. Dexmedetomidine as a Rescue Therapy for Emergence Delirium in Adults: A Case Series. *A A Case Rep*. 2017;9(1):20-3.

59. Han X, Sun X, Liu X, Wang Q. Single Bolus Dexmedetomidine Versus Propofol for Treatment of Pediatric Emergence Delirium Following General Anesthesia. *Paediatr Anaesth*. 2022;32(3):446-51.

60. Ibacache ME, Muñoz HR, Brandes V, Morales AL. Single-Dose Dexmedetomidine Reduces Agitation After Sevoflurane Anesthesia in Children. *Anesth Analg*. 2004;98(1):60-3.

61. Laskowski K, Stirling A, Mckay WP, Lim HJ. A Systematic Review of Intravenous Ketamine for Postoperative Analgesia. *Can J Anesth*. 2011;58:911-23. doi: 10.1007/s12630-011-9560-0.

62. Kim SH, Kim SI, Ok SY, Park SY, Kim MG, Lee SJ, et al. Opioid Sparing Effect of Low Dose Ketamine in Patients with Intravenous Patient-Controlled Analgesia Using Fentanyl After Lumbar Spinal Fusion Surgery. *Korean J Anesth*. 2013;64(6):524-8.

63. Sleigh J, Harvey M, Voss L, Denny B. Ketamine–More Mechanisms of Action Than Just NMDA Blockade. *Trends Anaesth Crit Care*. 2014;4(2-3):76-81.

64. Hintzsche K. Subanesthetic-Dose Ketamine to Decrease Emergence Delirium in the Surgical Patient With Posttraumatic Stress Disorder. *AANA J*. 2018;86(3):220-4.

65. White PF, Way WL, Trevor AJ. Ketamine-Its Pharmacology and Therapeutic Uses. *Anesthesiology*. 1982;56(2):119-36. doi: 10.1097/00000542-198202000-00007.

66. Ng KT, Sarode D, Lai YS, Teoh WY, Wang CY. The Effect of Ketamine on Emergence Agitation in Children: A Systematic Review and Meta-Analysis. *Paediatr Anaesth*. 2019;29(12):1163-72.

67. Coşkun AS. Comparing the Effects of Propofol and Ketamine on the Emergence Agitation of Male Children Undergoing Circumcision. *Ann Pediatr Surg*. 2022;18(2):1-6.

68. Hesse S, Kreuzer M, Hight D, Gaskell A, Devari P, Singh D, et al. Association of Electroencephalogram Trajectories During Emergence From Anaesthesia With Delirium in the Postanaesthesia Care Unit: An Early Sign of Postoperative Complications. *Br J Anaesth*. 2019;122(5):622-34.

69. Sener S, Eken C, Schultz CH, Serinken M, Ozsarac M. Ketamine With and Without Midazolam for Emergency Department Sedation in Adults: A Randomized Controlled Trial. *Ann Emerg Med*. 2011;57(2):109-14. e2.

70. Ykeizumi L, Correia da Silva R, Villar e Silva G, Martins Santiago BV. Combined Dexmedetomidine and Ketamine in Pediatric Anesthesia: A Brief Review. *Anesth Pain Res*. 2021;5(1):1-8.

71. Gupta K, Gupta A, Gupta PK, Rastogi B, Agarwal S, Lakhanpal M. Dexmedetomidine Premedication in Relevance to Ketamine Anesthesia: A Prospective Study. *Anesth. : essays res*. 2011;5(1):87-91.

72. Tobias JD. Dexmedetomidine and Ketamine: An Effective Alternative for Procedural Sedation? *Pediatr Crit Care Med*. 2012;13(4):423-7.

73. Cheng X, Huang Y, Zhao Q, Gu E. Comparison of the Effects of Dexmedetomidine-Ketamine and Sevoflurane-Sufentanil Anesthesia in Children with Obstructive Sleep Apnea after Uvulopalatopharyngoplasty: An Observational Study. *J Anaesthesiol Clin Pharmacol*. 2014;30(1):31-5.

74. Lee YS, Kim WY, Choi JH, Son JH, Kim JH, Park YC. The Effect of Ketamine on the Incidence of Emergence Agitation in Children Undergoing Tonsillectomy and Adenoidectomy Under Sevoflurane General Anesthesia. *Korean J Anesthesiol*. 2010;58(5):440-5.

75. Demir CY, Yuzkat N. Prevention of Emergence Agitation with Ketamine in Rhinoplasty. *Aesthetic Plast Surg*. 2018;42(3):847–53. doi: 10.1007/s00266-018-1103-4.

76. Aroke EN, Crawford SL, Dungan JR. Pharmacogenetics of Ketamine-Induced Emergence Phenomena: A Pilot Study. *Nurs Res*. 2017;66(2):105-14.

77. Strayer RJ, Nelson LS. Adverse Events Associated with Ketamine for Procedural Sedation in Adults. *Am J Emerg Med*. 2008;26(9):985-1028.

78. Abu-Shahwan I, Chowdary K. Ketamine is Effective in Decreasing the Incidence of Emergence Agitation in Children Undergoing Dental Repair Under Sevoflurane General Anesthesia. *Paediatr Anaesth*. 2007;17(9):846-50.

79. Domino EF, Warner DS. Taming the Ketamine Tiger. *Anesthesiology*. 2010;113(3):678-84.

80. Ibrahem Amin OA, Kamel AAF. Effects of Adding Ketamine to Dexmedetomidine on Smooth Recovery From Isoflurane Anesthesia in Adults Undergoing Endoscopic Sinus Surgery. *Egypt J Anaesth*. 2020;36(1):50-5.

81. Hadi SM, Saleh AJ, Tang YZ, Daoud A, Mei X, Ouyang W. The Effect of KETODEX on the Incidence and Severity of Emergence Agitation in Children Undergoing Adenotonsillectomy Using Sevoflurane Based-Anesthesia. *Int J Pediatr Otorhinolaryngol*. 2015;79(5):671-6.

82. Eger EI, Eisenkraft JB, Weiskopf RB. *The Pharmacology of Inhaled Anesthetics*. United States of America: Edward I. Eger; 2002.

83. Garcia PS, Kolesky SE, Jenkins A. General Anesthetic Actions on GABA-A Receptors. *Curr Neuropharmacol*. 2010;8(1):2-9.

84. Weir C, Mitchell S, Lambert J. Role of GABAA Receptor Subtypes in the Behavioural Effects of Intravenous General Anaesthetics. *Br J Anaesth*. 2017;119:i167-i75. doi: 10.1093/bja/aex369.

85. Kanaya A, Kuratani N, Satoh D, Kurosawa S. Lower Incidence of Emergence Agitation in Children After Propofol Anesthesia Compared with Sevoflurane: A Meta-Analysis of Randomized Controlled Trials. *J Anesth*. 2014;28(1):4-11.

86. Uezono S, Goto T, Terui K, Ichinose F, Ishguro Y, Nakata Y, et al. Emergence Agitation After Sevoflurane Versus Propofol in Pediatric Patients. *Anesth Analg*. 2000;91(3):563-6. doi: 10.1213/00000539-200009000-00012.

87. Kim Y-S, Chae YK, Choi YS, Min J-H, Ahn SW, Yoon JW, et al. A Comparative Study of Emergence Agitation Between Sevoflurane and Propofol Anesthesia in Adults After Closed Reduction of Nasal Bone Fracture. *Korean J Anesthesiol*. 2012;63(1):48-53.

88. Nakayama S, Furukawa H, Yanai H. Propofol Reduces the Incidence of Emergence Agitation in Preschool-Aged Children as Well as in School-Aged Children: A Comparison With Sevoflurane. *J Anesth*. 2007;21(1):19-23.

89. Kim H-J, Kim D-K, Kim H-Y, Kim J-K, Choi S-W. Risk Factors of Emergence Agitation in Adults Undergoing General Anesthesia for Nasal Surgery. *Clin Exp Otorhinolaryngol*. 2015;8(1):46-51.

90. Yu D, Chai W, Sun X, Yao L. Emergence Agitation in Adults: Risk Factors in 2,000 Patients. *Can J Anesth*. 2010;57(9):843-8.

91. Chandler JR, Myers D, Mehta D, Whyte E, Groberman MK, Montgomery CJ, et al. Emergence Delirium in Children: A Randomized Trial to Compare Total Intravenous Anesthesia with Propofol and Remifentanil to Inhalational Sevoflurane Anesthesia. *Paediatr Anaesth*. 2013;23(4):309-15.

92. Jo J-Y, Jung K-W, Kim H-J, Park S-U, Park H, Ku S, et al. Effect of Total Intravenous Anesthesia vs Volatile Induction With Maintenance Anesthesia on Emergence Agitation After Nasal Surgery: A Randomized Clinical Trial. *JAMA Otolaryngol Head Neck Surg*. 2019;145(2):117-23.

93. Grundmann U, Uth M, Eichner A, Wilhelm W, Larsen R. Total Intravenous Anaesthesia with Propofol and Remifentanil in Paediatric Patients: A Comparison with a Desflurane-Nitrous Oxide Inhalation Anaesthesia. *Acta Anaesthesiol Scand*. 1998;42(7):845-50.

94. Munk L, Andersen G, Møller A. Post-Anaesthetic Emergence Delirium in Adults: Incidence, Predictors and Consequences. *Acta Anaesthesiol Scand*. 2016;60(8):1059-66.

95. Cohen IT, Finkel JC, Hannallah RS, Hummer KA, Patel KM. Rapid Emergence does not Explain Agitation Following Sevoflurane Anaesthesia in Infants and Children: A Comparison with Propofol. *Paediatr Anaesth*. 2003;13(1):63-7.

96. Talih G, Yüksek A, Şahin E. Evaluation of Emergence Agitation After General Anaesthesia in Rhinoplasty Patients: Inhalation Anaesthesia Versus Total Intravenous Anaesthesia. *Am J Otolaryngol*. 2020;41(3):102387.

97. Pedersen N, Jensen A, Kilmose L, Olsen K. Propofol-Remifentanil or Sevoflurane for Children Undergoing Magnetic Resonance Imaging? A Randomised Study. *Acta Anaesthesiol Scand*. 2013;57(8):988-95.

98. Bryan YF, Hoke LK, Taghon TA, Nick TG, Wang Y, Kennedy SM, et al. A Randomized Trial Comparing Sevoflurane and Propofol in Children Undergoing MRI Scans. *Paediatr Anaesth*. 2009;19(7):672-81.

99. Huett C, Baehner T, Erdfelder F, Hoehne C, Bode C, Hoeft A, et al. Prevention and Therapy of Pediatric Emergence Delirium: A National Survey. *Paediatr Drugs*. 2017;19(2):147-53.

100. Rosen HD, Mervitz D, Cravero JP. Pediatric Emergence Delirium: Canadian Pediatric Anesthesiologists' Experience. *Paediatric Anesth*. 2016;26(2):207-12.

101. Abu-Shahwan I. Effect of Propofol on Emergence Behavior in Children After Sevoflurane General Anesthesia. *Pediatric Anesth*. 2008;18(1):55-9.

102. Aouad MT, Yazbeck-Karam VG, Nasr VG, El-Khatib MF, Kanazi GE, Bleik JH. A Single Dose of Propofol at the end of Surgery for the Prevention of Emergence Agitation in Children Undergoing Strabismus Surgery During Sevoflurane Anesthesia. *Anesthesiology*. 2007;107(5):733-8.

103. Haile S, Girma T, Akalu L. Effectiveness of Propofol on Incidence and Severity of Emergence Agitation on Pediatric Patients Undergo ENT and Ophthalmic Surgery: Prospective Cohort Study Design. *Ann Med Surg*. 2021;69(102765):1-5.

104. van Hoff SL, O'Neill ES, Cohen LC, Collins BA. Does a Prophylactic Dose of Propofol Reduce Emergence Agitation in Children Receiving Anesthesia? A Systematic Review and Meta-Analysis. *Paediatr Anaesth*. 2015;25(7):668-76.

105. Abbas MS, Abd El-Hakeem EE, Kamel HE. Three Minutes Propofol After Sevoflurane Anesthesia to Prevent Emergence Agitation Following Inguinal Hernia Repair in Children: A Randomized Controlled Trial. *Korean J Anesthesiol*. 2019;72(3):253-9.

Supplemental Material S7
General Information for the Lecture and Hands-On Training

How material is used: Training
Purpose: Use during development and rollout of the training program. The document identifies the learning objectives, participants, time requirements, when and where the training should occur, and required material/equipment.

Learning Objectives

Lecture
1. Restate risk factors that are associated with emergence delirium.
2. Identify team strategies to prevent, treat, and de-escalate episodes of emergence delirium.
3. Describe a medication strategy related to emergence delirium.
4. Identify medically appropriate manual restraints for patients exhibiting dangerous behavior related to emergence delirium.

Hands-On Training
1. Employ strategies to prevent, treat, and de-escalate dangerous and disruptive behavior associated with emergence delirium.
2. Utilize a team response to the patient actor exhibiting emergence delirium.
3. Employ safe and medically appropriate manual restraints with the patient actor exhibiting emergence delirium.

Who is Involved in the Training

- **Instructors**: They should collectively have expertise in perioperative clinical management of a patient and hands-on restraint of patients. The instructor teaching restraint should have formal training in how to safely conduct hands-on restraint.
- **Learners**: Staff who work in a perioperative environment, particularly staff who administer anesthetics and adjunct agents, staff who work in a post-anesthesia care unit, and other staff who could be called to assist with patient restraint.
- **Patient actor**: During simulation, this role will be performed by a person who has been thoroughly trained to resist in a way that does not cause harm to the learners or themselves. Ideally, the role will be performed by a standardized patient who is a medically trained educator or an instructor. In the event that no patient actors are available, then the instructor may consider using a mannequin in place of the patient actor.

When Should the Training Occur

- This training should be administered during rollout of the intervention and staff orientation, and as a refresher training as needed.
- Depending on the number of learners, we recommend that the instructor spend 30–60 minutes on the lecture and 30–60 minutes on the hands-on training (total of 60–120 minutes for both trainings).

Location and Required Materials/Equipment

Lecture
- The lecture should be given in a private room.
- Ideally, the instructor will use a projector or screen to show the PowerPoint file.
- All lecture materials are included in the packet of supplemental material.

Hands-On
- The training should be performed in a private room or a room specifically designed for operating room simulation.
- The simulation room should have at minimum a stretcher, gastrointestinal bed, or table. Also, we recommend using simulated intravenous fluids and oxygen.
- All other materials will come from this packet.

Supplemental Material S8
Agenda for the Lecture and Hands-On Training

How material is used: Training
Purpose: Provide the instructor with a concise list of training topics and corresponding durations

Recommended Time (Total 60–120 min)		Type of Training and Topics	Instructor(s)
2–4 min		**Introduction**	[enter name]
5–10 min	Lecture	**PAASO Form:** Preoperative Anesthesia Assessment, Medication Strategy, and Outcome	[enter name]
3–6 min		**Communication Among Staff**	[enter name]
2–4 min		**Adjust Environment**	[enter name]
5–10 min		**Medication Strategy**	[enter name]
5–10 min		**Patient Orientation Upon Emergence**	[enter name]
5–10 min		**Response to Emergence Delirium**	[enter name]
3–6 min		**Post-Emergence Delirium**	[enter name]
Transition			
5–10 min	Hands on (Guided Practice and Simulation)	**Prebrief**	[enter name]
10–18 min		**Guided Practice**	[enter name]
2–4 min		**Pre-Scenario 1 Talking Points**	[enter name]
3–5 min		**Simulation Scenario 1**	[enter name]
3–5 min		**Post-Scenario 1 Talking Points**	[enter name]
1–2 min		**Pre-Scenario 2 Talking Points**	[enter name]
3–6 min		**Simulation Scenario 2**	[enter name]
3–5 min		**Post-Scenario 2 Talking Points**	[enter name]
Transition			
0–5 min		**Highlights From Training**	[enter name]

Note: The times are simply a recommendation and should vary based on learner needs and time constraints at the healthcare facility

Supplemental Material S9

Perioperative Intervention To Prevent and Treat Emergence Delirium (PowerPoint, 19 slides plus talking points)

How material is used: Training

Purpose: Guide staff's skill development and facilitate rollout and continuity of the intervention. This content was designed to cover all components of the intervention.

For a copy of the **PowerPoint file with talking points (S9)**, go to the webpage for this article
(Vol. 4, No. 4 at PatientSafetyJ.com).

Perioperative Intervention To Prevent and Treat Emergence Delirium

- Presented by:
- [insert instructor names]

For a copy of the **PowerPoint file with talking points (S9)**, go to the webpage with the associated article (Vol. 4, No. 4 at PatientSafetyJ.com).

1

Learning Objectives

At the conclusion of this presentation, participants will be able to:

- Restate risk factors that are associated with emergence delirium
- Identify team strategies to prevent, treat, and de-escalate episodes of emergence delirium
- Describe a medication strategy related to emergence delirium
- Identify medically appropriate manual restraints for patients exhibiting dangerous behavior related to emergence delirium

2

Emergence Delirium

During the condition, the patient may engage in a wide range of behavior:

- Violence (e.g., punching, kicking, hitting, biting)
- Thrashing movement
- Aggression
- Combativeness
- Screaming

- Disconnect with current time and place (e.g., flashbacks, hallucinating),
- Attempting to exit bed/table
- Attempting to remove medical apparatuses

The condition begins with awakening from the anesthetic and/or adjunct agent and is followed by a return to baseline behavior after a short time period (typically less than 30 minutes).

3

Training Components

Lecture

- PAASO Form: Preoperative Anesthesia Assessment, Medication Strategy, and Outcome
- Communication among staff
- Adjust environment
- Medication strategy
- Patient orientation upon emergence
- Response to emergence delirium
- Post-emergence delirium

Hands-On Learning

- Team response and manual restraint
- Guided practice: instructor-modeled manual restraint, learner rehearsal, and feedback
- Simulation: learners, as a team, physically interact to mimic a real-life response to emergence delirium

4

PAASO Form: Preoperative Anesthesia Assessment, Medication Strategy, and Outcome

Part 1: Preoperative Anesthesia Assessment	Staff who complete part 1: Anesthesia provider Purpose: Identify patients who are at elevated risk for emergence delirium, further refine the medication strategy, gather information to orient the patient upon emergence, and facilitate hand-offs

1.1. Based on chart review and patient interview, is there a history of the following symptoms, conditions, or experiences (potential risk factors for emergence delirium)?

- ☐ NONE
- ☐ Previous occurrence of emergence delirium (confusion, anger, thrashing, flashbacks, hallucinations, screaming or hurt yourself or hurt someone else)
- ☐ Post-traumatic stress disorder (PTSD)
- ☐ Hypervigilance
- ☐ Flashbacks
- ☐ Irritability
- ☐ Exaggerated startle response

- ☐ Depression
- ☐ Anxiety
- ☐ Nightmares
- ☐ Sleep or mood disorder
- ☐ Traumatic brain injury (TBI)
- ☐ Traumatic event (e.g., sexually assaulted, domestic violence, combat)
- ☐ Substance use
- ☐ Other:

1.2. Based on chart review and patient interview, what is _your estimate_ of the patient's risk for emergence delirium?

☐ *Low* ☐ *Moderate* ☐ *High*

1.3. Based on chart review and patient interview, are there any current medications and/or substances used (drugs and alcohol) that may impact the effectiveness of analgesic or sedative agents? ☐*No* ☐*Yes*, list:

Questions to Facilitate Wake-Up

1.4A. At home, do you often wake up confused, angry or violent?

☐*No* ☐*Yes*, list:

1.4B. Is there anything specific I should do or not do (_triggers_) to wake you up at the end of your procedure? E.g., Don't touch me, only touch your left shoulder, gender preference for nursing care team, etc.

☐*No* ☐*Yes*, list:

1.4C. Are there any names that I can use to help orient you when you wake up? E.g., your nickname, family member, pet

5

PAASO Form: Preoperative Anesthesia Assessment, Medication Strategy, and Outcome

Part 2: Medication Strategy	Staff who complete part 2: Anesthesia provider Purpose: Facilitate hand-offs and monitor the perioperative intervention across department providers	
2.1. Medications administered during *pre-operation, induction, and/or maintenance of anesthesia phases*	☐ Dexmedetomidine ☐ Fentanyl ☐ Hydromorphone ☐ Ketamine ☐ Acetaminophen	☐ Propofol ☐ Remifentanil ☐ Midazolam ☐ Volatile agent ☐ Oral opiates
2.2. Preemergence	☐ NONE ☐ Dexmedetomidine	☐ Hydromorphone ☐ Propofol
2.3. If applicable, in *response to emergence delirium*	☐ NONE ☐ Dexmedetomidine	☐ Propofol ☐ Midazolam

Part 3: Outcome	Staff who complete part 3: Anesthesia provider or PACU nurse Purpose: Monitor effectiveness of the intervention across department providers and facilitate collecting information for patient record

3.1. Was there an episode of emergence delirium? E.g., violence, thrashing, aggression, combativeness, screaming, hallucinating, attempting to exit bed/table, and/or attempting to remove medical apparatuses	☐*No* ☐*Yes*
If yes emergence delirium (3.1): **3.2A. Was the behavior dangerous?**	☐*No* ☐*Yes*, describe:
3.2B. Was anyone injured?	☐*No* ☐*Yes*, describe:
3.2C. What may have triggered the episode? E.g., loud sound, bright light, or tactile stimulus	Describe:

6

Communication Among Staff

- Implement plan across perioperative phases to help staff recognize the high-risk patient (e.g., patient wears a unique colored cap or wristband)
- Transitions of care (e.g., ensure communication about patient's risk status of emergence delirium)
- During time-out discuss patient's risk status for emergence delirium, plan to treat, and staff roles
- Use overhead paging system to announce "Anesthesia stat" when staff support is required. Announce location and room number.

7

Preoperative and Postoperative Adjustment of Environment

Proactively prevent triggers
- Quiet room and away from high-traffic area
- Dim lights
- Consolidate/limit unnecessary staff interactions (e.g., avoid interactions with trainees)

Proactively prepare for dangerous behavior
- Adjust bed or table (e.g., lock wheels, pad side rails, mechanical restraints, secure arm boards and/or stirrups)
- Secure IV with extra tape and then wrap with gauze

8

Medication Strategy

Preoperation Preparation	Sequence of Meds	Intravenous (IV)/Monitored Sedation With or Without Regional Anesthesia	General Anesthesia With or Without Regional Anesthesia
Immediately prior to transfer to operating room	1	**Acetaminophen**: 1000–1300 mg, oral	
	2	*Optional* **Dexmedetomidine**: 8–20 mcg (0.25–0.5 mcg/kg ideal body weight, titration to effect), IV	
		Optional, one of the following:	
		• **Fentanyl**: 50–100 mcg, IV	
	3	• **Hydromorphone**: 0.2–1.0 mg, IV (**Note**: not administered as a premedication with regional anesthesia)	
		• **Oral Opioid**	

Note: With dexmedetomidine, the clinically effective onset of sedation occurs 5–10 minutes after bolus administration.

Induction of Anesthesia	Sequence of Meds	Intravenous (IV)/Monitored Sedation With or Without Regional Anesthesia	General Anesthesia With or Without Regional Anesthesia
Administration of an agent to provide sedation or general anesthesia as necessary	1	**Lidocaine**: 50–100 mg, IV	
	2	**Propofol**, *one or both* of the following: • **Bolus**: Incremental doses, 25–100 mg, IV • **Infusion**: 25–150 mcg/kg/min, IV	**Propofol**, *both* of the following: • **GETA**: 1.0–2.0 mg/kg, IV • **Infusion**: 50–150 mcg/kg/min, IV
	3	***Ketamine**: <0.5 mg/kg (low dose ketamine, maximum of 50 mg), IV	
	4	***Hydromorphone**: 0.2–1.0 mg, IV	

Note: *During most procedures we (VAPHS) recommend use of Ketamine and/or Hydromorphone as an analgesic.

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Medication Strategy

Phases	Types of Anesthesia and Medications		
Maintenance of Anesthesia	Sequence of Meds	Intravenous (IV)/Monitored Sedation With or Without Regional Anesthesia	General Anesthesia With or Without Regional Anesthesia
Maintain desired level of anesthesia required for the procedure	1	**Propofol infusion**: 25–150 mcg/kg/min, IV	
	2	**Dexmedetomidine**: • *Optional* **loading dose**: 0.5–1.0 mcg/kg, IV, over 10 minutes • **Infusion**: 0.2–1.0 mcg/kg/hour, IV	
	3	Not applicable	*Optional* **Remifentanil infusion**: 0.04-0.1mcg/kg/min, IV
	4	***Ketamine**: <0.5 mg/kg (low dose ketamine, maximum of 50 mg), IV	
	5	***Hydromorphone**: 0.2–2.0 mg, IV	

Note: A dexmedetomidine infusion alone can be used with a limited number of specific procedures (e.g., awake fiberoptic intubation) as an IV/monitored sedation. *During most procedures we (VAPHS) recommend use of ketamine and/or hydromorphone as an analgesic.

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Medication Strategy

Phases	Types of Anesthesia and Medications		
	Sequence of Meds	**Intravenous (IV)/Monitored Sedation With or Without Regional Anesthesia**	**General Anesthesia With or Without Regional Anesthesia**
Emergence- Patient awakens from anesthesia leading to the greatest potential for emergence delirium	1	**Preemergence, *bolus* or *infusion* of dexmedetomidine:** • **Bolus:** 8–20 mcg (0.25–0.5 mcg/kg ideal body weight, titration to effect), IV, repeat as needed • **Infusion:** 0.2–1.0 mcg/kg/hour, IV (**loading dose:** 0.5–1.0 mcg/kg, IV, over 10 minutes)	
	2	**Preemergence, hydromorphone bolus:** 0.2-1.0mg, IV, repeat as needed	
	3	**Preemergence, if not previously administered, acetaminophen infusion:** 1000 mg, IV, over 20 minutes	
	4	**Post-emergence, if patient demonstrates low-to-moderate-risk behavior, *bolus* or *infusion* of dexmedetomidine:** • **Bolus:** 8–20 mcg (0.25–0.5 mcg/kg ideal body weight, titration to effect), IV, repeat as needed • **Infusion:** 0.2–1.0 mcg/kg/hour, IV (**loading dose:** 0.5–1.0 mcg/kg, IV, over 10 minutes)	
	5	**Post-emergence, if patient demonstrates moderate-to-high-risk behavior, *bolus* or *infusion* of propofol:** • **Bolus:** 50–200 mg, IV, repeat as needed • **Infusion:** 50–150 mg/kg/min, IV	

Note: *We* (VAPHS) *do not recommend* administering ketamine pre-emergence (late in the case), as this may increase the likelihood of emergence delirium.

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Patient Orientation Upon Emergence

- Mention familiar people and places (e.g., patient's name and nickname, names of immediate family members, pet's name, location)
- Use patient's preferred physical interactions (e.g., tap on right shoulder and do not touch legs)
- Use patient's gender preference for the nursing care team
- Present comforting visual cues (e.g., picture projected onto ceiling of the U.S. flag)

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Response to Emergence Delirium

Extra staff support
- Call "Anesthesia stat" for additional support
- A minimum of four staff will be involved in managing and treating patient behavior

Manual restraint
- The purpose is to prevent the patient from harming themselves and staff
- Manual restraint refers to staff placing their hands directly on the patient to secure a limb or area of the body
- More information to follow on subsequent slides and during hands-on practice/simulation

Protect IV access and airway

Administer medication, if necessary, to help manage patient behavior
- Dexmedetomidine or propofol
- See medication strategy for more information

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Manual Restraint Simulation Video

Note: This video is an example of staff who were <u>learning</u> manual restraint in a simulation with a patient actor

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Appropriate Manual Restraint Techniques

- Manual restraint should only be instructed by an expert and someone who is familiar with local regulations
- Manual restraint techniques will focus on the patient's arms, legs, head, oxygen, and IV location
- Following this presentation, an expert on manual restraint will demonstrate appropriate techniques and learners will practice those techniques

15

Patient Positions During Manual Restraint

Recommended patient positions
- Supine
- Side – patients who are pregnant or obese
- Standing escort technique – apply only if patient exits the table or bed

Not recommended patient positions
- Prone

16

Risks with Manual Restraint

Positional asphyxiation
- Weight should never be applied to the patient's thoracic cavity

Aspiration
- Risk should be low due to patient's NPO status

Orthopedic injuries
- Do not exceed patient's range of motion
- Do not use joint lock or pain compliance techniques

Skin integrity
- Apply a measured amount of force during restraint and do not default to full force

17

Post-Emergence Delirium

Debrief meeting with patient and family
- Provide the patient with a prepared document explaining emergence delirium
- Prior to discharge provide the patient with a referral or contact information to a mental health service

Debrief meeting among staff
- Discuss alternative explanations for the delirium
- Do we know what triggered the episode?
- Could the episode have been prevented?
- Discuss team response and what should be improved

Documentation
- File an event report with the patient safety office or risk management
- Add a detailed note to the patient's record

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Thank you!

[Insert instructor contact information]

For supporting information and references, please see the associated article and other supplemental materials in Vol. 4, No. 4 at PatientSafetyJ.com

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Supplemental Material S10
Outline of Phases, Roles, and Materials for the Hands-On Training

How material is used: Training
Purpose: Provide the instructor with information about phases, roles, and materials used during the hands-on training

Phases		Roles			Supplemental Material
		Patient Actor	**Learner**	**Instructor**	
Pre-Brief (5–10 min)		Instructor reads the pre-brief to all personnel involved. This includes supportive learning environment, confidentiality, fiction contract, learning objectives, roles, time-out, and psychological safety.			◄S11
Guided Practice (10–20 min)		Guided practice consists of instructor-modeled manual restraint, learner rehearsal, and immediate feedback to the learner (i.e., behavior skills training). Guided practice involving instructor-supported step-by-step instruction with gradual fading of modeling and prompts until the learner demonstrated proficiency.			◄S12
Note: The following phases, roles, and materials apply to both simulation scenario 1 and scenario 2					
Simulation Pre-Scenario Talking Points (2–4 min)		Instructor reads pre-scenario talking points to all personnel involved. This includes a reminder of safety, scenario context, starting and stopping points, and answering questions.			◄S13
Simulation Scenario (3–5 min)	**Starting Behavior**	Begin lying on a bed or stretcher in the supine or side position	Stand to the side or at the foot of the bed	Present with learners and prepared to closely observe their behavior	◄S14, S15
	Intervening Behavior	Emerges from anesthesia by yelling, sitting up in the bed, pulling at their arm or face to simulate removal of IV or oxygen	• Call for assistance (e.g., "Anesthesia stat") • Attempt to verbally orient the patient actor • Apply manual restraint techniques to the patient actor (identical to training) • Protect IV and airway, if necessary • Administer medication to sedate the patient actor • One team member acts as an observer to monitor patient's safety	Continuously moves to a position within the room to observe all learners, monitoring safety and learner performance against the simulation checklist	
	End Behavior	Once the patient actor determines that the learners have applied restraint correctly, then they will stop resisting	Restraint applied to the patient	Verifies that learners performed tasks correctly and then stops the scenario	
Simulation Post-Scenario Talking Points (3–5 min)		Provides feedback to learners about their restraint application and any safety concerns	Receives feedback on their performance and asks questions	Reviews simulation checklist and provides feedback to learners and facilitates discussion with the post-scenario talking points	◄S13, S15

Supplemental Material S11
Pre-Brief for the Hands-On Training

How material is used: Training

Purpose: Provide personnel with fundamental information about the components of the hands-on training. Conveying this information is essential to ensure that everyone understands their roles, behavioral expectations, and the context of the hands-on training.

Components	Description
Supportive Learning Environment and Confidentiality	Hands-on training is intended to be a supportive learning environment. This means that it is a safe space to make mistakes and discuss questions, difficulties, or errors. The learner will be an active participant in the hands-on training as well as an observer of peers. All actions, discussions, and feedback that occur in this session should not be shared with others outside of the training. Likewise, the training team will not speak about learner performance or direct comments to supervisors, co-workers, etc.
Fiction Contract	The simulation environment and patient actor have certain limitations in their ability to exactly mirror real life. The learner is expected to suspend judgement of realism when the simulation does not precisely match real life. Learners should engage with the same amount of care, respect, and attention that would be given in a real-world event of this nature.
Learning Objectives	1. Employ strategies to prevent, treat, and de-escalate dangerous and disruptive behavior associated with emergence delirium. 2. Utilize a team response to the patient actor exhibiting emergence delirium. 3. Employ safe and medically appropriate manual restraints with the patient actor exhibiting emergence delirium.
Environment	The simulated operating room has been set up to appear as close to real as can be accomplished. The room will include simulated operating room equipment such as the anesthesia gas machine (AGM), intravenous (IV) infusion pump, vital signs monitors, and wall-mounted and supplied oxygen and suction.
Roles	**Patient actor**: This role should be fulfilled by an instructor or medically trained educator (e.g., standardized patient) that will portray the patient. They are permitted to provide resistant force against the restraints and have been thoroughly trained to resist in a way which does not cause harm to the learner or to themselves. They have been trained to maintain their balance and remain aware of their limbs and head. The actors may push against the learners' restraint hold but will not strike or attack the learners in any way. The actors are permitted to resist, sit up, and attempt to remove simulated medical interventions (such as the IV). **Learners**: They are permitted to touch and manually restrain the patient actor. They are not permitted to strike, push, trip, lift, takedown to the ground, press against a wall, choke, or place any pressure on the thoracic cavity of the actor. They must not use any technique that they may have learned outside of this training. Any restraints used should follow the proper physical intervention as instructed in the emergence delirium training courses regarding arm control, standing escort, and supine or side manual restraints. **Instructors**: They may act as other responding team members but will not initiate or take the lead with any verbal intervention or restraints; they will only take cues from learners and provide support after all participating learners have attempted to apply the manual restraint. Instructors will always acknowledge before the start of a simulation if they are participating or not.
Time-Out	At any time, the instructors, learners, or patient actor may call a "time-out" and stop the hands-on training, in the event that something is unsafe. Instructors may also call a time-out to provide further instruction or guidance. Learners may also call a time-out if they become stuck and would like help formulating a new strategy.
Simulation Pre- and Post-Scenario Talking Points	Immediately before and after each of the two simulation scenarios, the instructor will address a few talking points. In the pre-scenario talking points, the instructor will communicate what will happen during the scenario and what they expect the learner to demonstrate. In the post-scenario talking points, the instructor will discuss what went well and what didn't go well.
Psychological Safety	The simulation scenarios may be a trigger or hit close to home for some of the learners. If that is the case, they are not obligated to participate and can feel free to step out or take a break at any time. If staff do not complete the training, they are instructed not to use manual restraint.

Supplemental Material S12
Guided Practice for the Hands-On Training

How material is used: Training

Purpose: Guided practice consists of instructor-modeled manual restraint (i.e., hands-on) followed by learner rehearsal with immediate instructor feedback (i.e., behavior skills training).

Overview of Guided Practice

Guided practice consists of instructor-modeled manual restraint (i.e., hands on) followed by learner rehearsal with immediate instructor feedback (i.e., behavior skills training). This process will start slowly and include step-by-step instruction with gradual fading of modeling and prompts until the learners demonstrate proficiency. In the first round of practice, the patient actor (e.g., standardized patient or instructor) will offer light resistance against the restraint to help the learner safely measure the effectiveness of their hand placement and force. After the first round of restraint practice, the process will restart with the patient actor engaging in increased resistance against the restraint and using greater variability of movement. This process will repeat until the learners demonstrate proficiency (typically two to three rounds of practice are required).

Manual Restraint Description

1. This section is not intended to be a "how-to" restraint application guide. Please consult your local restraint expert for additional information about how to safely apply manual restraint.
2. Arms – Pressure will be applied to the shoulder area and below the elbow (forearm) of both arms. At no time should pressure be applied to the elbow joint. The arms will remain in line with the body and will not be manipulated in a way that produces pain to force compliance. The arms will not be maneuvered away from the body or exceed the patient's natural range of motion.
3. Legs – Pressure will be applied to the thighs and shin areas. The legs can typically support pressure that is placed above or below the knees, but not directly on the knees.
4. Head – It may be necessary to support the head of the patient in a way that will prevent the patient from removing or dislodging the oxygen apparatus. Pressure may be placed on the patient's forehead and under the chin, but at no time should weight be applied to the neck (i.e., do not use a choke hold).
5. Intravenous (IV) site – The area around the IV site will need to be secured to prevent IV removal. This will be accomplished by cupping a hand over the IV site to prevent dislodgment.
6. General guidelines – Do not apply weight to the thoracic cavity of the patient and do not lie across the patient's upper body, which may restrict the patient's respiration. Please note that learners may have difficulty gauging the difference between adequate and excessive force when restraining a patient; therefore, this topic should be emphasized during training.

Supplemental Material S13
Simulation Pre- and Post-Scenario Talking Points for the Hands-On Training

How material is used: Training

Purpose: The pre-scenario talking points will convey fundamental information to the learners and patient actors about the expected behavior. The post-scenario talking points will facilitate learning and evaluation.

Pre-Scenario Talking Points

Context for the scenario: It will begin with the surgical team having just completed surgery and preparing for the patient to emerge from sedation and orient to the environment. As a reminder, the actor will engage in behavior associated with emergence delirium.

Sequence of events: The instructor will announce "Begin" to start the simulation. The simulation is expected to last approximately 3–5 minutes. Once the scenario begins, the learners are expected to assess and react to the situation as trained, except for making real calls for assistance. Instead, the learners may simulate a call by picking up a phone and announcing who they would call and what they would say.

We are about to begin the scenario. Please keep the following in mind during the scenario:
- Patient actor will be restrained in a [side or supine] position.
- Patient actor will not strike anyone.
- Call a time-out if you need help or see a safety concern.
- Learner should call for assistance (e.g., "Anesthesia stat").
- Learners should attempt to verbally orient the patient. For example, the learner will state the patient's name (e.g., Rebecca Smith), her spouse's name (e.g., John Smith) and where the procedure is being performed (e.g., Pittsburgh, Pennsylvania).
- Learners should only use restraint techniques taught in this course.
- If appropriate, a learner should protect the airway and IV.
- If appropriate, a learner should simulate re-sedation of the patient actor.
- A learner should act as an observer to monitor the patient actor's safety.

Any questions before we begin the scenario?

Post-Scenario Talking Points

- Overall, how did the scenario go? *Purpose of question*: Will get the learners to begin talking about their experience.
- What was your role in the scenario? *Purpose of question*: Instructor will use the learners' responses to determine if all roles were performed as trained.
- What went well? *Purpose of question*: Instructor will use the learners' responses to evaluate whether they recognize what tasks were performed correctly. Instructor will also use this as an opportunity to praise their performance.
- What didn't go well? *Purpose of question*: Instructor will use the learners' responses to determine if they recognize what tasks were performed incorrectly and better understand what challenges they encountered. This is an opportunity for the patient actor to provide feedback to the learner. Depending on the learners' performance, the instructor may need to rerun the scenario.
- **Other questions the instructor may want to pose**
  o Did you perform your technique(s) as trained? If you varied from the technique, do you know why?
  o Did the team clearly communicate the safety needs of the patient?
  o What was most helpful about this scenario?
  o What would you do differently next time?
- Do you have any questions or concerns about the training or simulation?

Supplemental Material S14
Simulation Scenarios 1 and 2 for the Hands-On Training

How material is used: Training
Purpose: Identifies learning objectives, context, setting information, and expected behavior during the scenario. This will be used by the patient actor and instructor during planning and implementation of the simulation training.

Components	Description
Learning objectives	1. Learner will employ strategies to prevent, treat, and de-escalate dangerous and disruptive behavior associated with emergence delirium. 2. Learners will utilize a team response to the patient actor exhibiting emergence delirium. 3. Learners will employ safe and medically appropriate manual restraints with the patient actor exhibiting emergence delirium.
Information for both scenarios	1. **Background on emergence delirium**: The condition often begins with awakening or emergence from the anesthetic and/or adjunct agent and is followed by a return to baseline behavior after a short time period (typically less than 30 minutes). During the bout of emergence delirium, the patient may engage in a wide range of behavior that includes one or more of the following: violence, thrashing movement, aggression, combativeness, screaming, disconnect with current time and place, attempting to exit bed/table, and/or attempting to remove medical apparatuses. 2. **Patient actor behavior**: While waking from anesthesia, the actor demonstrates emergence delirium by yelling; attempting to get up from the table/stretcher; attempting to remove an intravenous (IV) line or oxygen; and acting as if they are confused, agitated, and hallucinating (flashbacks of a traumatic experience). The actor will engage in behavior that would indicate that they should be manually restrained by the learner. The actor should not attempt to strike the learner and must avoid causing harm. 3. **Learner behavior**: The learners will use specific techniques to manually restrain the actor. 4. **Required equipment**: At minimum a stretcher, gastrointestinal bed, or table. Also, we recommend using a simulated IV and oxygen. 5. **Location**: A private room or a room specifically designed for operating room (OR) simulation 6. **Information for verbal orientation of patient:** The learner will use names and locations to verbally orient the patient actor during their simulated bout of emergence delirium. For example, the learner will state the patient's name (e.g., Rebecca Smith), her spouse's name (e.g., John Smith), her dog's name (e.g., Jaffy), and where the procedure is being performed (e.g., Pittsburgh, Pennsylvania). 7. For additional information to prepare the patient actor, see **S10, "Outline of Phases, Roles, and Materials for the Hands-On Training."**
Information for scenario 1	1. **Patient actor's position during simulation**: The actor will start the scenario lying in a *supine* position and will end by being restrained in a *supine* position. 2. Patient actor had complaints of abdominal pain and is waking from an appendectomy procedure.
Information for scenario 2	1. **Patient actor's position during simulation**: The actor will start the scenario lying in a *side* position and will end by being restrained in a *side* position. 2. Patient actor had complaints of gastrointestinal pain and is waking from a colonoscopy procedure.

Supplemental Material S15
Simulation Checklist for the Hands-On Training

How material is used: Training
Purpose: Instructor uses it to facilitate staff learning and evaluation

Scenario 1: Manual Restraint of Supine Position	Yes	No	Comments
1. Did a team member call for assistance (e.g., "Anesthesia stat")?			
2. Did a team member attempt to verbally orient the patient by saying familiar names and locations?			
3. Did a team member manually restrain the patient's **right arm** correctly?			
4. Did a team member manually restrain the patient's **left arm** correctly?			
5. Did a team member manually restrain the patient's **legs** correctly?			
6. Did a team member manually restrain the patient's **head** correctly?			
7. If necessary, did the team protect the **airway and the IV**?			
8. If necessary, did a team member administer medication to resedate the patient?			
9. Did a team member act as an observer to monitor patient's safety?			
Scenario 2: Manual Restraint of Side Position	**Yes**	**No**	**Comments**
1. Did a team member call for assistance (e.g., "Anesthesia stat")?			
2. Did a team member attempt to verbally orient the patient by saying familiar names and locations?			
3. Did a team member manually restrain the patient's **right arm** correctly?			
4. Did a team member manually restrain the patient's **left arm** correctly?			
5. Did a team member manually restrain the patient's **legs** correctly?			
6. Did a team member manually restrain the patient's **head** correctly?			
7. If necessary, did the team protect the **airway and the IV**?			
8. If necessary, did a team member administer medication to re-sedate the patient?			
9. Did a team member act as an observer to monitor patient's safety?			