Postanesthesia Care Unit (PACU)

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Disclosures

• None, except:

• I am using edited slides that were originally produced and used by Dr. Cynthia Wells and Dr. Li Meng.

Overview

• Purpose and “phases” of a PACU stay
• Criteria for PACU Discharge
• Common and Uncommon PACU Problems
• Checklist for a safe and effective PACU Transfer
Why a PACU?

- Majority of post-op pts require a period of physiologic stabilization.
- A relatively high incidence of potentially life-threatening resp and circulatory complication
  - Phase 1 – Monitoring and staffing ratio equivalent to an ICU
  - Phase 2 – Transition to floor or home
- Some patients are admitted directly to the ICU
- “PACU Bypass”

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Aldrete Score

Discharge from Phase 1

Score ≥ 8

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PACU Bypass or “Fast tracking”

- Anesthetics with rapid offset or sedation
- Regional anesthetic techniques
- Modified Aldrete Score: ≥ 12 for discharge

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<tr>
<th>Post-op Pain Assessment</th>
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<tr>
<td>None or mild discomfort</td>
<td>2</td>
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<td>Moderate to severe pain controlled with IV analgesics</td>
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<td>Persistent severe pain</td>
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<th>Post-op Emetic Symptoms</th>
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<tr>
<td>None or mild nausea with no active vomiting</td>
<td>2</td>
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<td>Transient vomiting or retching</td>
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<td>Persistent nausea and vomiting</td>
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PACU Admission

• Report to PACU staff:
  o Past medical history & allergies
  o Surgical procedure and any complications
  o Intra-op events
    • Cardiac arrest, bleeding, etc.
  o Anesthetic course
    • Difficult intubation
    • Reversal of neuromuscular blockade
    • Antibiotics, Analgesics, Anti-emetics, Fluids
• Initial PACU vital signs are the final entry of the intraop anesthetic record
• (More on this later)

Potential Issues in the PACU

• Ventilation Problems
• Hemodynamic Instability
• Postop pain, nausea and vomiting
• Delayed emergence
• Oliguria
• Hypothermia
• Agitation (emergence delirium)

Most common ventilatory issues

• Upper Airway Obstruction
  o Pharyngeal – tongue
  o Laryngeal – laryngospasm, edema

• Arterial Hypoxemia
  o PaO₂ < 60 mmHg
  o Atelectasis, dec. FRC, alveolar hypoventilation

• Hypoventilation
  o PaCO₂ > 45 mmHg
  o Residual anesthetic or muscle relaxant; opioids
  o Co-existing COPD, pain, surgical site, positioning

• Postop intubation...
Extubation Criteria

- State of consciousness
- VC greater than 15 ml/kg
- Inspiratory force greater than -20 cmH₂O
- Acceptable pH and ABG at 40% FiO₂

Special Considerations

- Difficult intubations
- Obstructive sleep apnea
- Reactive airway disease
- Aspiration
- Pneumothorax
- Pulmonary edema
- Pulmonary embolus

Obstructive Sleep Apnea

- Challenging ventilation/intubation
- Only extubate after full reversal and fully conscious
- Avoid the supine position
- More susceptible to the respiratory depressant effects of anesthetics
Obstructive Sleep Apnea

- Prolonged risk of hypopneas/apneas and desaturation/hypercarbia
  - Continuous pulse ox monitoring
- Consider starting CPAP/BiPAP in PACU

Pulmonary Edema

- Volume overload
- Cardiogenic – preceded by hyper- or hypotension leading to LV failure
  - Negative Pressure Pulmonary Edema
    - Noncardiogenic

Negative Pressure Pulmonary Edema

- Generation of negative intrathoracic pressure against a closed glottis (laryngospasm, biting the ETT)
  - Inc. systemic vascular and pulmonary capillary hydrostatic pressure
  - Mechanical stress at alveolar-capillary level
- Decreased O₂ sat, pink frothy fluid, wheezing, dyspnea
- Airway support, PEEP, diuretics, fluid restriction
  - Resolves in 12-24 hrs
Aspiration

- Usually evident upon seeing gastric contents or bile at time of intubation/extubation or trauma
- Rapid onset of profound hypoxemia
  - Reflex airway closure/bronchospasm
  - Loss of surfactant → atelectasis
  - Loss of capillary integrity → pulmonary edema

- Loss of airway reflexes increases risk
- Outcome varies with type and volume of aspirate
- Suction airways and support ventilation
- Chest X-ray may be normal in first 24 hrs
- Steroids and prophylactic antibiotics not beneficial

Pneumothorax

- Arterial hypoxemia due to compressed alveoli and R → L shunt
- Asymmetric breath sounds
- Reasons:
  - Central line placement?
  - Surgical procedure
    - Thoracic → occluded chest tube?
    - Laparoscopic surgery or nephrectomy
    - Neck dissection
    - Mastectomy
Approach to respiratory emergencies

- Supplemental O$_2$ plus ensure airway patency
  - Simple chin lift, neck extension
  - Oral/nasal airway
  - Mask ventilation/CPAP/Reintubation
  - Bronchoscopy
- Bronchoconstriction - Inhaled beta-agonist
- Chest X-ray
- Diuretics
- Chest tube insertion for symptomatic pneumothorax or > 20%

Cardiovascular Issues

- Hypo- or Hypertension
- Tachycardia
- Arrhythmias
- Myocardial ischemia

Hypertension and tachycardia

- Hyperdynamic phase is common
- Most often:
  - PAIN
  - Essential hypertension
  - Hypoventilation/hypercarbia
  - Hypothermia and shivering
  - Bladder distention
Hypertension and tachycardia

- Maintain a broad differential diagnosis:
  - Hypoxemia
  - Fever
  - Anemia
  - Hypoglycemia
  - Tachydyrsyrhythmias
  - Withdrawal
  - Myocardial ischemia
  - Medications

- Rarely:
  - Hyperthyroidism
  - Pheochromocytoma
  - Malignant hyperthermia

Hypotension

- Hypovolemia #1 cause
- Surgical blood loss/anemia
- Ongoing hemorrhage
- Heart failure
- Dysrhythmias
- Ischemia
- Sepsis/anaphylaxis
- Tension pneumothorax

Treatment of Hypotension

- Assess intravascular volume
- Fluid bolus – ? Response
- Vasopressor or inotropic support
- Failure to respond → invasive monitoring
- ? Cardiac dysfunction or valvular disease
- Tension pneumothorax requires immediate treatment
**Myocardial Ischemia**

- Angina present in <¼ pts experiencing ischemia
- Risk factors: LVH, htn, DM, pre-existing CAD, h/o CHF, valvular disease, low EF
- Precipitated by:
  - Fluid overload
  - Increased afterload or hypotension
  - Tachycardia/dysrhythmias

**Physiologic consequences of myocardial ischemia**

- Hypoxemia
- Hypercarbia
- Hypovolemia
- Pain
- Hypothermia
- Ischemia
- Hypertension
- Electrolyte abnormality
- Hypokalemia
- Hypocalcemia
- Hypomagnesemia
- Resp acidosis
- Preop dysrhythmias
- Inc. sympathetic tone
Treatment of Cardiac Dysrhythmias

- Rule out respiratory causes
- Pt’s history?
- Is pt hemodynamically stable? → possible cardioversion
- Attenuate sympathetic factors such as pain or anxiety
- 12-lead EKG
- Check electrolytes

Delayed emergence or “Slow to awaken”

- Failure to progress beyond protective airway reflexes and minimal conscious awareness
- Review medical history and surgical procedure
- ABC’s
  - Hypoxia
  - Hypercarbia
  - Hypocarbia

Delayed emergence or “Slow to awaken”

- Medication Effect
  - Premeds
  - Neuromuscular blockade
  - Anesthetics
  - Other meds
  - Substance abuse

- Metabolic
  - Hyponatremia
  - Hypoglycemia
  - Hypothermia
  - Hepatic encephalopathy
  - Hypothyroidism
  - Addison’s/Cushing’s
Delayed emergence or “Slow to awaken”

- Neurologic
  - Ictal or post-ictal state
  - CVA
  - Cerebral edema and elevated ICP

- Baseline condition

Oliguria

- Urine output < 0.5 ml/kg/hr
- Prerenal
  - Hypovolemia, hypotension & hypoperfusion
- Renal
  - ATN – ischemia, toxins, myoglobin
  - Intrinsic disease
- Postrenal
  - Obstructed catheter, BPH
- Baseline condition??

Hypothermia

- Core body temp < 36°C
- Physiologic effects of 33°C
  - HTN tachycardia
  - Increased oxygen consumption
  - Hyperventilation
  - Prolonged drug metabolism
- MAC decreases 5-7%/°C fall in body temp
**Hypothermia**

- Shivering increases CO₂ production, CO₂ and O₂ consumption 300-400%
- Anesthetic induced vasodilation and redistribution of heat
- Muscle relaxation and inhibition of shivering
- OR temp 20°C and cold IV fluids
- Demerol effectively suppresses shivering postop

**4 Mechanisms of Heat Loss**

- Evaporation
- Convection
- Radiation
- Conduction

**Agitation or Emergence Delirium**

- ABC’s
  - Hypoxia
  - Hypercarbia
- Medication effect
  - Premeds
  - Home meds
  - Withdrawal
- Bleeding
- Pain
- Anxiety
- Discomfort
- Disorientation
- Distended bladder
- Movement disorder
- Baseline
Nausea and Vomiting

- Most common postop problem – 20-30% pts
- Risk factors:
  1. H/o PONV or motion sickness
  2. Female
  3. Non-smoker
  4. Anesthetic factors (opioids, nitrous oxide, volatiles)
    - Controversial:
      • FMV, neostigmine, type of surgery (eye muscle, middle ear, laparoscopic)
    - Disproved:
      • BMI, cycle of menstrual cycle, short- vs. long-acting opioids, supplemental O2 (FiO2 >0.8), g-tube decompression

PAIN

- #1 cause for treatment in PACU
- Causes multiple issues
  o HTN, tachycardia, hypoventilation, agitation, PONV
- Multimodal therapy –
  o Opioids
  o NSAIDs
  o Local anesthetic infiltration
  o Regional anesthesia
Incidental Trauma

• Ocular injuries and visual changes
  o Corneal abrasions
  o Ischemic optic atrophy – prone, hypotension, anemia, long surgery

• Oral and pharyngeal injuries
  o Dental, lip, tongue, hoarseness, sore throat

• Nerve injuries - ulnar

PACU Admission Checklist
PACU admission checklist

- Patient identification (name, age, sex, language or comprehension limits such as hard of hearing/blindness)
- Diagnosis, surgical procedure and surgeon.
- Brief medical history

PACU admission checklist

- Allergies and daily medications.
- Anesthetic course, technique, agents used, complications.
- Intraoperative meds (time and dose): antibiotics, muscle relaxation agents, reversal admission, antiemetics, beta-blockers and pain meds.

PACU admission checklist

- Intubation and extubation problems
- Anticipated need for pain medications.
- Intraoperative fluid balance, types of fluid, blood loss and replacement.
- Intraoperative laboratory data.
PACU admission checklist

• Intraoperative line placement and management plan (PAC, CVP, A-line)
• Airway management plans for the intubated patient.
• Anticipated problems

PACU admission checklist

• Postanesthetic orders (e.g. oxygen administration, ventilator settings, fluid administration, antiemetic and analgesic treatment)

Antiemetics

• Prochlorperazine (Compazine) 5 mg Administer IV, may repeat x__ for a total of__ mg PRN N/V
• Ondansetron (Zofran) 4 mg Administer IV, may repeat x__ for a total of 8 mg PRN N/V (OR and PACU doses combined)
• Metoclopramide (Reglan) 10 mg IV, may repeat x__ for a total of__ mg PRN N/V (Give slowly over 3-4 minutes)
• Dexamethasone ___mg IV ONE TIME ONLY
Analgesics

- Morphine (mg) __ mg IV every __ minutes for __ mg total dose
- Hydromorphone (mg) __ mg IV every __ minutes for __ mg total dose
- Fentanyl (mcg) __ mcg IV every __ minutes for __ mcg total dose
- Meperidine __ mg IV one time only, use for SHIVERING

Antihypertensive therapy

- Labetolol __ mg every __ minutes for total of __ mg for BP >
- Hydralazine __ mg every __ minutes for total of __ mg for BP >
- Metoprolol __ mg every __ minutes for total of __ mg for BP > __ or HR >

“PAAAIAP”

- Patient info (history, diagnosis, surgery)
- Allergies
- Anesthesia (course, drugs)
- Airway
- Ins/Outs
- Anticipated Needs/Complications/Follow up
- Postanesthesia orders
Summary!

Summary

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Questions?