

BACKGROUND

- Administering safe general anesthesia can be challenging for patients with severe pulmonary hypertension due to risks for cardiopulmonary depression.
- Alternatively, regional anesthesia serves as an attractive option to provide surgical analgesia without disrupting a patient's ventilatory drive or hemodynamic status.

PURPOSE

- Review anesthetic considerations for patients with severe pulmonary hypertension and the utility of regional blockade for surgical analgesia.

CASE DESCRIPTION

PATIENT PRESENTATION

The patient is a 58 year-old male, admitted for right open ankle fracture after falling from stairs.

Past Medical History

- Newly diagnosed pulmonary hypertension
- HIV
- Lower extremity neuropathy
- Type 2 diabetes

Patient was hypoxic on room air with SPO2 reaching 90%-95% while on high flow nasal cannula. Chest CTA ruled out pulmonary embolism, but echocardiography showed right ventricular dysfunction associated with estimated pulmonary artery systolic pressure of 60mmHg.

INTRA-OP MONITORING:

- Used standard ASA monitors
- Placed awake arterial line

AVOIDING SEDATION:

- Plan to minimize sedation to maximize respiratory drive
- Use regional blockade for intraoperative surgical analgesia
 - Popliteal blockade with 30mL 0.5% bupivacaine
 - Adductor canal blockade with 20mL 0.25% bupivacaine
- Avoid / minimize opioids

VENTILATORY STRATEGY:

- Allowed spontaneous ventilation
- Kept patient in upright position to optimize respiratory mechanics
- Used non-rebreather face mask
- Used oxygen mixed with inhaled nitric oxide

INTRA-OP COURSE:

- Patient remained comfortable throughout the procedure
- Tolerated surgical stimulation after regional blockade

END OF SURGERY:

- Patient was weaned off inhaled nitric oxide and transitioned back to high flow nasal cannula oxygen
- Patient was then transported back to the medical floor without drips or pressers

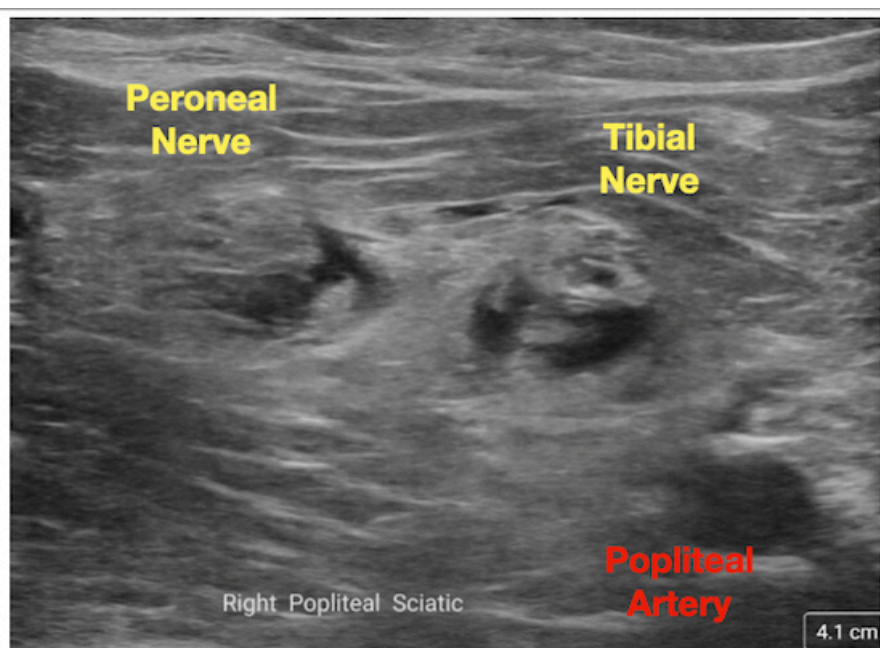


Image 1: Ultrasound image of right popliteal blockade after deposition of 30mL 0.5% bupivacaine perineurally.

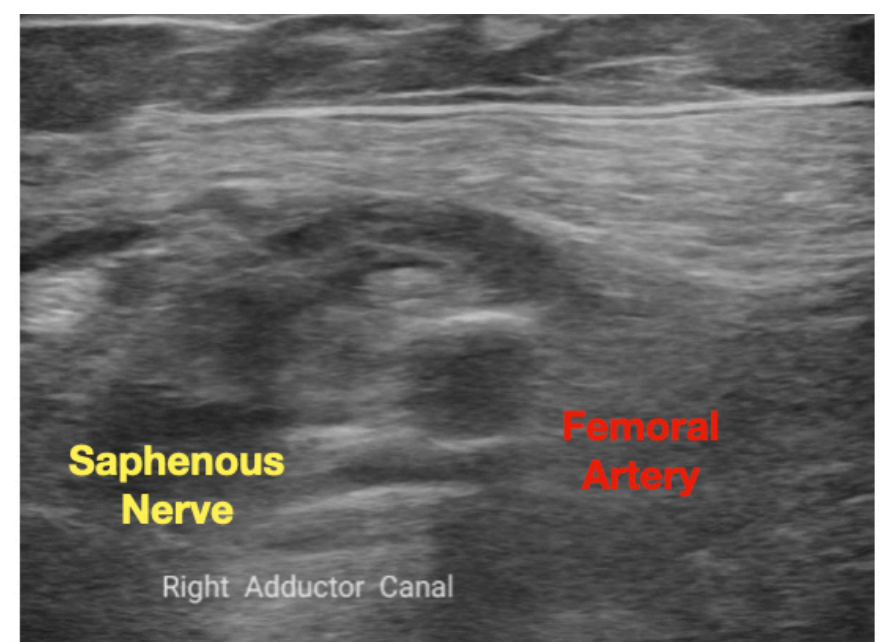


Image 2: Ultrasound image of right adductor canal blockade after deposition of 20mL 0.25% bupivacaine perineurally.

DISCUSSION:

Comparing Regional vs. General Anesthesia

Regional Anesthesia: Advantages

- Minimal hemodynamic effects
- Minimal effects on ventilatory drive
- Provides post-op pain control, which minimizes post-op opioids and hypoventilation

Regional Anesthesia: Disadvantages

- Less effective oxygen and gas delivery
- Inability to perform TEE without general anesthesia

Cases to Consider Regional Anesthesia

- Hernia or GU Surgery: can use epidural for continuous infusion and avoid neuraxial bolus dosing
- Extremity Surgery: nerve blocks or catheters for orthopedic procedures

General Anesthesia: Advantages

- More effective delivery of oxygen and inhaled agents
- Ability to perform TEE on patient

General Anesthesia: Disadvantages

Several aspects of general anesthesia cause significant hemodynamic shifts in PA pressure or SVR, including:

- Induction
- Intubation
- Laryngoscopy
- Positive pressure ventilation

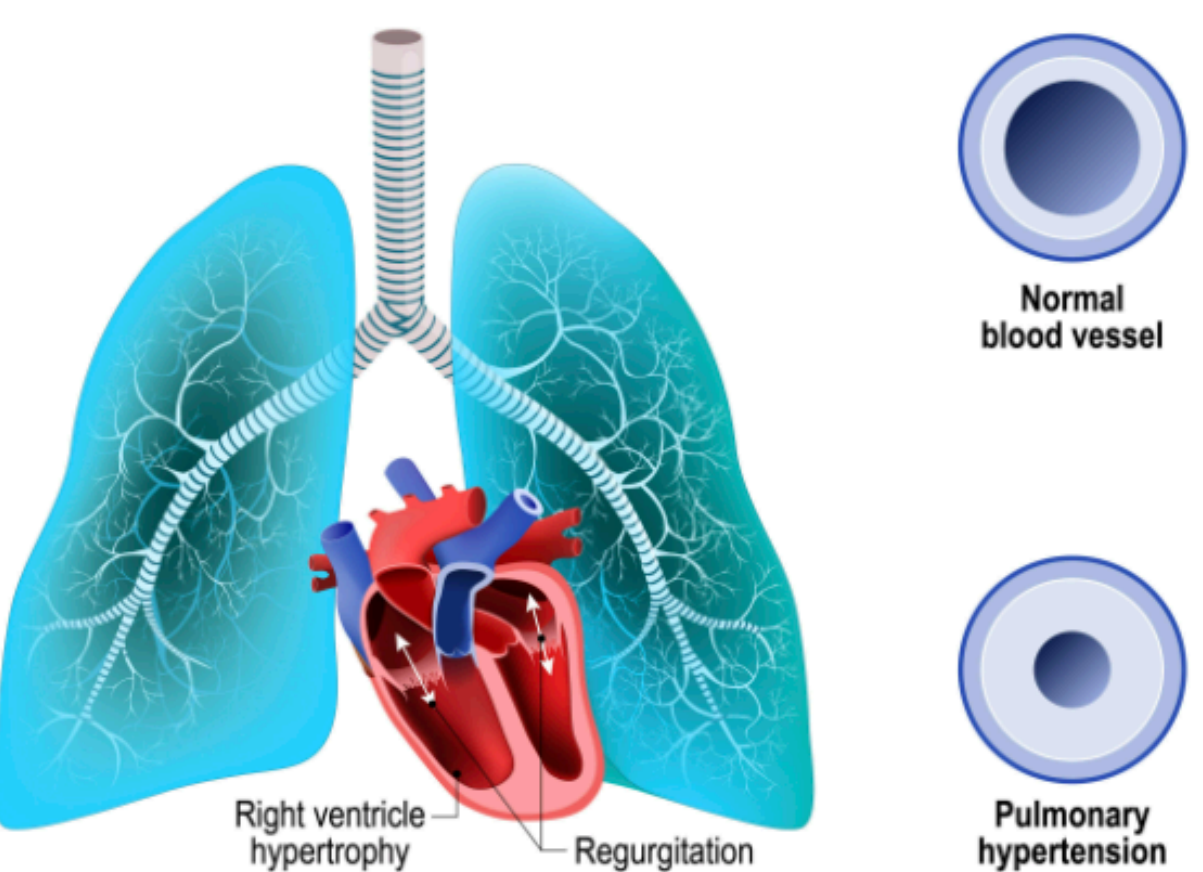
Cases to Consider General Anesthesia

- Abdominal surgery: can use GA + epidural
- Thoracic surgery: can use GA + thoracic epidural
- Can consider GA if patient cannot tolerate lying flat

DISCUSSION: Anesthetic Management of Pulmonary Hypertension

Physiologic Concepts:

- Avoid increases in PA pressure
- Avoid increases in RV afterload
- Avoid decrease in RV contractility
- Minimize systemic hypotension



O2, CO2, & fluids

- Hypoxia induces pulmonary vasoconstriction
- Ideally keep FiO2 0.6-1.0
- Avoid hypercapnia and acidosis
- Keep moderate hyperventilation for paCO2 30-35mmHg and pH above 7.4
- Aim for adequate fluid administration to ensure adequate right heart preload
- Avoid shivering and hypothermia

IV Vasodilators

- Milrinone - increase contractility & lowers PVR
- Dobutamine - increase contractility & lowers PVR
- Sildenafil - lowers PVR
- Nitroglycerin - lowers SVR & PVR
- Nitroprusside - lowers SVR & PVR

Inhaled Vasodilators

- Nitric oxide
- Inhaled prostacyclin
- Inhaled iloprost

Advantage:

- Acts directly on pulmonary vasculature
- Has minimal effects on systemic vasculature
- vasodilatation at ventilated areas lead to decrease pulmonary shunt and improved oxygenation

Considerations:

- When choosing IV vasodilatng agents, need to consider effects on SVR, PVR, & cardiac function

CONCLUSION

- In certain orthopedic procedures, successful regional blockade can minimize or eliminate the need for general anesthesia and intubation. Among pulmonary hypertension patients, this provides a wider margin of safety by minimize hemodynamic insults in the perioperative setting.

REFERENCES:

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2. Price LC, Martinez G, Brann A, Pickworth T, Samarasinghe C, Alexander D, Garfield B, Aw TC, McCabe C, Mukherjee B, Harries C, Kempny A, Gatzoulis M, Marino P, Kiely DG, Condliffe R, Howard L, Davies R, Coghlan Schreiber BE, Lordan J, Taboada D, Gaine S, Johnson M, Church C, Kemp SV, Wong D, Curry A, Levett D, Price S, Ledot S, Reed A, Dimopoulos K, Wort SJ. Perioperative management of patients with pulmonary hypertension undergoing non-cardiothoracic, non-obstetric surgery: a systematic review and expert consensus statement. Br J Anaesth. 2021 Apr;126(4):774-790. doi: 10.1016/j.bja.2021.01.005. Epub 2021 Feb 19. PMID: 33612249.



Image 2a: Example image of simple face mask used in spontaneous ventilation



Image 2b: Example image of endotracheal tube used in positive pressure ventilation