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Dexmedetomidine vs Propofol for Cardiopulmonary Bypass

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Abstract

Propofol has been used as part of balanced anesthetic in cardiovascular surgery patients. Dexmedetomidine is newer agent with multiple benefits and may be superior than propofol.
A 68-year-old male with history of CAD, GERD, T2DM, OSA, was undergoing an elective coronary bypass graft surgery. The patient in this case report received dexmedetomidine infusion throughout the procedure as well as postoperatively. Patient maintained cerebral oximetry > 50, did not suffer from arrythmias, his hemodynamic was stable, his ICU course was short, and patient was also extubated in 2 hours after arrival to the unit. In addition, patient did not suffer from post-operative delirium. Dexmedetomidine infusion during cardiac surgery may be superior to propofol infusion due to better prevention of ventricular arrythmia, hemodynamic stability, reducing length of mechanical ventilation and ICU stay, and prevention of postoperative delirium.

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Introduction

- Cardiovascular surgery poses increased risk for several complications including neurologic insult, postoperative dysrhythmias, cognitive disorders, myocardial ischemia, stroke, coma, heart block, acute renal failure, increased ICU stay and prolonged mechanical ventilation.[2-6]
- Dexmedetomidine has emerged in the maintenance of anesthesia during cardiac surgery as compared to propofol.[2-6]

Purpose

- This case study will review both agents to see if one is superior in providing better hemodynamic stability and patient outcomes while undergoing cardiopulmonary bypass.

Preanesthetic Evaluation

- 68-year-old, 85 kg, 180 cm, male CABG x3.
- **PMH:** CAD, GERD, T2DM, HTN, OSA, Angina.
- **PSH:** L knee arthroplasty (SAB -->without anesthesia complications)
- **Cardiac Cath report:** LHC: 60% stenosis of prox. LAD, 60% stenosis of RIA, 70% stenosis of OM1, ECHO: EF=60% without evidence of significant stenosis or regurgitation of valves.
- **Pertinent labs**: H/H: 14.0/42, PLT 325
- **Pre-Op VS:** BP 140/87 mmHg, HR 85, O2Sat 100%, RR 12, 36.8°C.
- Airway assessment: MP2, FROM of neck, TMD < 3FB, ULBT Class I, >3FB mouth opening
- Anesthetic Plan: GETA with standard ASA monitors, A line, central line, PA catheter, and cerebral saturation monitor.

Intraoperative Anesthetic Management

- **Monitors:** Standard plus pre-induction A-line, PAC, foley catheter.
- **Induction:** Preoxygenation, IV induction: lidocaine 100 mg, fentanyl 100 mcg, etomidate 14 mg, propofol 50mg, and succinylcholine 130 mg, Miller 2, Grade I view, 8.0 ETT.
- **Maintenance:** Sevoflurane Et 0.9-1.3% in a mixture of O_2 1 L/min and dexmedetomidine infusion at 0.3mcg/kg/hr. Norepinephrine infusion titrated for MAP goal of 70mmHg. 2
- On Pump: dexmedetomidine 0.3mcg/kg/hr only
- Off Pump: 250mL of 5% albumin and epinephrine infusion 0.01mcg/kg/min for CI goal 2.2. Norepinephrine was continued at 0.3mcg/kg/min. 2300mL cellsaver blood administered. Patient received total of 1000 mcg of fentanyl and 250mcg of sufentanil. Plasma glucose maintained with insulin drip 1-3U/hour
- Cerebral oximetry monitoring WNL
- **Case Totals:** 2000mL crystalloid, UOP 1100 mL, EBL 100mL, 5 hours of anesthesia time.
- Patient remained intubated and transferred to ICU on dexmedetomidine at 0.4mcg/kg/hr and norepinephrine at 0.03mcg/kg/min.

Postoperative Evaluation

- **PostOp VS:** BP 114/72 mmHg, HR 76, O2Sat 100%, RR 16, and temperature 36.7°C.
- The patient was extubated 2 hours post arrival to ICU, remained free of complications and postoperative delirium. Discharged to home on POD day 5.

Pharmacology Review

	Dexmedetomidine	Propofol
MOA[1]	• Potent alpha 2 adrenergic agonist (a2:a1 = 1620: 1) works by inhibiting pontine locus ceruleus causing decrease in SNS activity and level of arousal causing sedation	• $GABA_A$ agonist leading to decrease rate of dissociation of inhibitory neurotransmitter. (prolongs duration of hyperpolarization of cell membrane of chloride channel when GABA binds)
CV[1]	• Hypotension & bradycardia	• Hypotension & blunted tachycardic response to hypotension
Neuro[1]	• Decrease CBF& no change in $CMRO_2$ • Neuroprotective	• Decrease in CBF & $CMRO_2$
Pharmacokinetic[1]	• Highly protein bound • Hepatic metabolism/kidney excretion	• Clearance of propofol from plasma > hepatic BF • Hepatic metabolism/kidney excretion
Uses[1]	• Attenuating hemodynamic response to intubation • Decrease catecholamine level intraop • Decrease periop requirement for inhaled anesthetic and opioid • Potential anesthetic of choice for difficult airway, post-op shivering and post op sedation	• Induction of anesthesia • IV sedation • Maintenance of anesthesia • Antiemetic • Antipruritic • Anticonvulsant • Attenuation of bronchoconstriction.

Literature Review

	Dexmedetomidine	Propofol
Cerebral tissue O_2 Sat[2]	• No significant decrease in $rScO_2$ & mini-mental state exam • neuroprotective	No significant decrease in $rScO_2$ & mini-mental state exam Neuroprotective
Hemodynamic stability[4]	• Lower percentage of increase in HR, SBP, DBP was noted at skin incision and sternotomy • Same pressor requirement	• Same pressor requirement
Length of stay in ICU & length of mechanical ventilation[4]	• ICU stay: 92 hours • Post op ventilation: 5.9 hours	• ICU stay : 133.46 hours • Post op ventilation: 8.6 hours
Post op arrythmia[3,6]	• Not shown to reduce A fib • Shown to reduce VT	• Not shown to reduce A fib
Post op delirium[5]	• Systematic review of 56 articles showed dexmedetomidine to be superior pharmacologic agent in preventing postop delirium when compared to other pharmacologic agents such as propofol, ketamine, and opioids.	
Introp opioid and anesthetic sparing property[7]	• 13.1 mg total required on average during intraop • Lower MAC of isoflurane requirement to maintain BIS of 40-60	• 16.05mg total required on average during intraop

Discussion

- The patient in this case report received dexmedetomidine infusion throughout the procedure as well as postoperatively. Due to the infusion, volatile anesthetic and opioid requirement were reduced. Patient was also able to remain calm while on ICU ventilator.
- Both propofol and dexmedetomidine preserve cerebral O2 saturation.[2] The patient also maintained cerebral oximetry WNL (rSCO2> 50) during this case.
- Dexmedetomidine does decrease ventricular dysrhythmias (eg PVC, VT) compared to propofol.[3,6] The patient in this case report did not suffer from atrial or ventricular dysrhythmias.
- Dexmedetomidine has better hemodynamic stability.[4] This was also true in this case study, patient maintained heart rate & BP during incision and sternotomy.
- Dexmedetomidine has been associated with reduced ICU stay and decreased prolonged mechanical ventilation.[4] The patient in this case study was extubated 2 hours after arrival to the unit without complications.
- Dexmedetomidine has been shown to be superior to other agents in preventing postoperative delirium (eg, midazolam, propofol, opioids, ketamine).[5] The patient in this case study had normal neurologic exam preoperatively(A&OX4). 3-hour postoperative exam (1 hour post-extubation) was normal without evidence of delirium(A&OX4).

Conclusion

- Dexmedetomidine infusion during cardiac surgery may be superior to propofol infusion in preventing ventricular dysrhythmias, providing better hemodynamic stability, reducing length of mechanical ventilation and ICU stay, opioid and anesthetic sparing property, and preventing of postoperative delirium.[1-7]

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