

Case report

Opioid-free total intravenous anesthesia for valvular cardiac replacement surgery

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Abstract

A 44-year-old woman with rheumatic heart disease with severe mitral stenosis, moderate–severe mitral regurgitation, and severe tricuspid regurgitation underwent mitral valve replacement and tricuspid repair under cardiopulmonary bypass using opioid-free total intravenous anesthesia (OF-TIVA) with propofol, ketamine, lidocaine, and dexmedetomidine, combined with a transversus thoracic plane (TTP) block. The patient's intraoperative hemodynamics remained stable, and the patient was extubated six hours postoperatively with minimal pain and no complications. OF-TIVA with TTP block provided effective analgesia, hemodynamic stability, and early recovery, thus highlighting its potential as a safe alternative to opioid-based anesthesia in cardiac valve surgery.

Keywords: Cardiopulmonary bypass, mitral valve replacement, opioid free total intravenous anesthesia, rheumatic heart disease, tricuspid valve repair.

Rheumatic heart disease (RHD) is a chronic result of untreated Group A streptococcal infection, causing autoimmune inflammation and progressive valvular damage. It remains a primary cause of valvular disease in developing countries, especially among young people. In Indonesia, RHD ranks fourth, with approximately 1.18 million cases and a mortality rate of 4.8 per 100,000 individuals, driven by limited healthcare access, low awareness, and inadequate prevention efforts.^(1–3)

Opioid-free anesthesia (OFA) employs non-opioid agents to minimize opioid-related side effects, particularly in patients with cardiac conditions. In thoracic and cardiovascular surgery, OFA provides stable hemodynamics, faster recovery, and fewer respiratory complications. A meta-analysis found no significant difference in 24-h postoperative pain between OFA and opioid-based anesthesia but revealed that OFA significantly reduced nausea, vomiting, inotrope use, and the need for non-invasive ventilation.⁽⁴⁾

This case report aimed to demonstrate the feasibility and perioperative benefits of opioid-free total intravenous anesthesia (OF-TIVA) in valvular cardiac surgery under cardiopulmonary bypass (CPB). Although previous meta-analyses have reported favorable outcomes with OFA, there is limited evidence regarding the use of OFA combined with total intravenous anesthesia (TIVA) as the primary anesthetic method employed in complex valvular cardiac surgery.

Case report

A 44-year-old woman with a history of RHD presented to the National Cardiovascular Center Harapan Kita with three years of easy fatigability, palpitations, and exertional dyspnea, without chest pain or edema. Physical exam revealed stable vital signs, an irregular heart rhythm, and a holosystolic murmur. Furthermore, a chest X-ray revealed cardiomegaly (cardiothoracic ratio > 50.0%), and coronary angiography showed normal coronary arteries.

Transthoracic echocardiography (TEE) showed left ventricle dilation with an ejection fraction of 59.0% and an enlarged left atrium (180 mL/m²) and right atrium (23 cm²), with tricuspid annular plane systolic excursion (16 mm), indicating mild right ventricle dysfunction. Valvular assessment revealed severe mitral stenosis (MS), moderate–severe mitral

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regurgitation (MR), and severe tricuspid regurgitation (TR). The patient was diagnosed with RHD (ASA III) and scheduled for mitral valve replacement (MVR) and tricuspid valve repair (TVR) under CPB.

Anesthesia was performed using the OF-TIVA technique. A bilateral transversus thoracic plane (TTP) block was performed under ultrasound guidance at the parasternal region between the T2 and T5 intercostal spaces. The needle tip was advanced into the fascial plane between the internal intercostal and transversus thoracic muscles, where local anesthetic was deposited to block the anterior cutaneous branches of the T2–T6 intercostal nerves. Bilateral TTP blocks were administered with 0.25% bupivacaine (20 mL) plus 1:200,000 epinephrine per side before induction. Induction included 1 mg/kg of propofol, 0.3 mg/kg of ketamine, 1.5 mg/kg of lidocaine, 1.2 mg/kg of rocuronium, 0.5 µg/kg of dexmedetomidine, and 1 g of paracetamol. Maintenance included the continuous infusion of 50–150 µg/kg/min of propofol, 0.25 mg/kg/h of ketamine, 1.5 mg/kg/h of lidocaine, 0.5 mg/kg/h of rocuronium, and 0.25 µg/kg/h of dexmedetomidine, titrated to bispectral index.

Moreover, intraoperative TEE showed a mitral valve area of 0.86 cm², a gradient of 8 mmHg, TR with a vena contracta of 0.73 cm, and a tricuspid annulus of 4.1 cm. After standard surgical preparation, the patient was positioned supine, then the skin was disinfected, and the patient was draped in sterile

drapes. A median sternotomy was performed, and the pericardium was opened. Heparin (300 mg) was administered before cannulation. After achieving the target activated clotting time, cannulation of the aorta, superior vena cava, and inferior vena cava was performed, followed by the initiation of CPB.

MVR and TVR were completed in 212 min (CPB 88 min; cross-clamp 66 min), with 800 mL of blood loss and transfusions of 237 mL of packed red blood cells, 632 mL of fresh-frozen plasma, and 157 mL of thrombocyte concentrate. Weaning from CPB was smooth with dobutamine at 5 µg/kg/min and milrinone at 0.375 µg/kg/min. The intraoperative hemodynamic profile is shown in **Figure 1**. Post-CPB TEE revealed good mechanical valve function without paravalvular leak.

The patient arrived in the intensive care unit hemodynamically stable (blood pressure 109/57 mmHg, heart rate 92 bpm, SpO₂ 99%) on 20 mg/50 mL of dobutamine. Mechanical ventilation was continued for 6 hours before extubation. Postoperative analgesia included 0.5 µg/kg of dexmedetomidine, 1.5 mg/kg of lidocaine, and 1 g of paracetamol every 8 hours. The patient stayed in the intensive care unit for less than 24 hours without complications and was transferred to intermediate care in a stable condition. Postoperative pain assessment was performed using the Behavioral Pain Scale and Visual Analog Scale on the first day after extubation, with scores of <4 and <3, respectively.

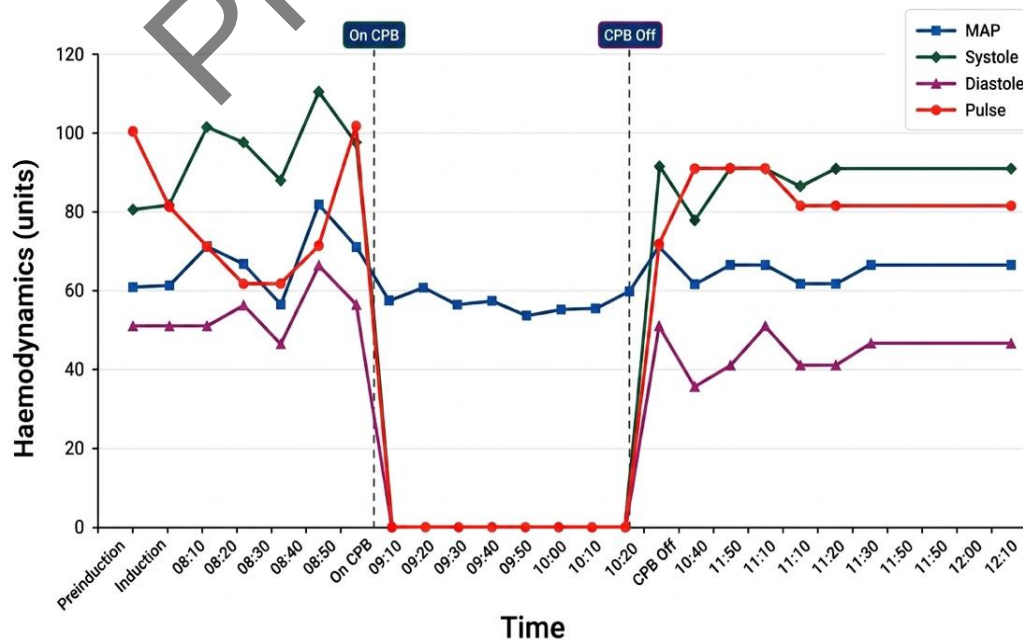


Figure 1. Patient haemodynamic profile.

Discussion

Patients with combined MS, MR, and TR are at high risk of intraoperative hemodynamic instability. In MS, cardiac output is fixed; therefore, sudden decreases in preload or afterload can reduce coronary perfusion and precipitate pulmonary congestion. Conversely, in MR and TR, increased afterload exacerbates regurgitation, whereas fluid overload may worsen systemic congestion. In addition, elevated pulmonary vascular resistance must be avoided, as it can increase right ventricular afterload and reduce cardiac output. Therefore, anesthetic management should focus on maintaining hemodynamic stability, preserving sinus rhythm, keeping the patient's heart rate within the low-normal range (<70 bpm), and carefully managing fluids and ventilation to optimize cardiac function during surgery.^(5–8)

The OF-TIVA approach follows the same principles and objectives as the general anesthetic management of MS, MR, and TR. The agents used, such as ketamine and lidocaine, reduce nociceptive hypersensitivity and decrease the requirement for primary anesthetics. Furthermore, dexmedetomidine provides sedation, analgesia, and sympathetic stability without causing respiratory depression. Propofol is a hypnotic agent with minimal vasodilatory effects that maintains hemodynamic stability. The TTP block reduces sternotomy-related pain by providing targeted analgesia to the sternotomy site and anterior thoracic wall, thus making it particularly suitable for open-heart surgeries, such as MVR and TVR.

Studies utilizing OFA combined with thoracic regional blocks in coronary artery bypass graft procedures have demonstrated intraoperative hemodynamic stability, minimal postoperative pain, early extubation, and absence of opioid-related side effects. The use of the TTP block as an alternative to the erector spinae plane (ESP) block represents a relevant innovation in the context of median sternotomy, as this technique is relatively simple, safe for patients under full heparinization, and provides adequate analgesia for the central incision area.⁽⁹⁾

A randomized control trial comparing the analgesic efficacy of TTP block and ESP block in pediatric cardiac surgery found that the TTP block provided superior outcomes, facilitating faster extubation (fast-track) and doubling the likelihood of ultra-fast-track extubation. However, this advantage was accompanied by a higher incidence of side effects that appeared unrelated to the quality of analgesia provided.⁽¹⁰⁾

Conclusion

Anesthetic management for patients with RHD presenting with MS, MR, and TR undergoing MVR and TVR primarily focuses on maintaining sinus rhythm, preventing tachycardia, and optimizing preload and afterload to preserve adequate cardiac output. Compared with opioid-based anesthesia, OF-TIVA provides more stable hemodynamics and avoids opioid-related adverse effects. Furthermore, OF-TIVA offers effective analgesia and sympatholysis without significant respiratory compromise, facilitating early extubation, faster recovery, and favorable postoperative respiratory function.

Author contributions

MR and AAW contributed substantially to the study concept and design, data acquisition, literature review, and data analysis and interpretation. MR and AAW contributed substantially to data acquisition. MR and AAW contributed to drafting the manuscript. MR and AAW edited the manuscript critically for important intellectual content. All authors approved the final version submitted for publication and take responsibility for statements made in the published article.

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Conflicts of interest statement

No potential conflict of interest was reported by the author(s).

Data sharing statement

Data generated or analyzed for the present report are included in this published article. Further details are available from the corresponding author on reasonable request after deidentification of the patient whose data are included in the report.

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