TIVA in Cardiac Surgery

Yatin Mehta[1] Anil Karlekar[2] Shweta Suri Kandpal[1]

[1]Medanta Institute of Critical Care and Anesthesiology, Medanta The Medicity, Gurgaon, Haryana, India
[2]Department of Cardiac Anaesthesia and Critical Care, Fortis Escorts Heart Institute, New Delhi, India

Address for correspondence YatinMehta, MD, FRCA, Institute of Critical Care and Anesthesiology, Medanta The Medicity, Gurgaon, Haryana, India (e-mail: yatinmehta@hotmail.com).

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Over the years, as for cardiac surgery, anesthesia too has undergone tremendous advancements in understanding of anesthetic agents mechanism and their monitoring. Studies have been underway with the ultimate goal of improving patient outcome, in terms of intraoperative hemodynamic parameters, myocardial protection, postoperative recovery, length of hospital stay, preservation of neurocognitive integrity, and long-term morbidity and mortality.

The cardioprotective effects of volatile anesthetics versus total intravenous anesthesia (TIVA) are controversial. Research has long been advocating volatile agents as preferred choice for myocardial protection. The beneficial effect of volatile anesthetics was termed "anesthetic preconditioning" (APC)

This occurred independent of changes in systemic and coronary hemodynamics, and persisted despite discontinuation of the volatile anesthetic before coronary artery occlusion, a "memory" period similar to that observed during ischemic preconditioning. Also, volatile anesthetics were shown to protect myocardium against ischemic injury when administered 24 to 72 hours before (termed "delayed" or "late" preconditioning) or immediately after (known as "postconditioning") prolonged coronary artery occlusion.[1]

The Mortality in Cardiac Surgery Randomized Controlled Trial of Volatile Anesthetics (MYRIAD) trial, a randomized, single-blind trial, conducted at 36 centers in 13 countries did not reveal any significant difference in number of deaths at 30 days or at 1 year, in patients undergoing elective, isolated coronary artery bypass graft surgery, receiving intraoperative anesthesia with a volatile anesthetic or TIVA.[2]

Kapoor et al in a study comparing TIVA with desflurane in AVR showed no significant difference in troponin I (cTnI) and ischemia-modified albumin as a biomarker for myocardial injury, between both the study groups. However, the post-cardiopulmonary bypass cTnI level was significantly higher than baseline in the TIVA group, demonstrating a cardioprotective ischemia preconditioning effect of desflurane.[3]

However, a Scandinavian registry of 10,535 patients undergoing a variety of cardiac surgical procedures revealed that patients with preoperative unstable angina and/or recent myocardial infarction, and thus already "preconditioned," did not show any difference in mortality between TIVA and volatile anesthetic groups. On the contrary, patients suffering from preoperative myocardial ischemia actually benefited from propofol anesthesia, due to its antioxidant effects. Cardiopulmonary bypass itself causes reperfusion injury that, when most severe, is clinically manifested as a systemic inflammatory response syndrome. The use of propofol during bypass is associated with a less adverse inflammatory profile than isoflurane, as shown by lower levels of cytokines and inflammatory biomarkers up to 24 hours post-surgery.[4]

In cardiac surgery, assessment of mitral regurgitation (MR) for valve replacement or repair is done under general anesthesia. A randomized controlled trial demonstrated that pre-existing MR might change differently from preoperative to intraoperative transesophageal echocardiogram according to the type of anesthetic agent. MR may be more underestimated with isoflurane anesthesia than with TIVA.[5] Correct assessment of MR is important to take the decision whether to repair or replace the mitral valve and to assess the repair.

TIVA is highly effective in providing deep plane of anesthesia. Adequacy of TIVA depends on maintenance of brain concentrations in equilibrium with plasma levels. Al-Rifai suggested target-controlled infusions as the best way to achieve this state. They used the bolus/elimination/transfer principle to approximate a constant plasma level of drug.[6]

Also suggested was that clinicians quoted awareness as the reason to avoid TIVA; however, technical errors and poor application of knowledge were highlighted in the NAP5

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report as the major cause of awareness during TIVA, and 75% of these cases would have been prevented by suitable education and training. National Institute of Health and Clinical Excellence (NICE)has recommended deployment of a processed electroencephalography device when administering TIVA and NAP5 emphasized that this is particularly necessary in patients who require neuromuscular paralysis. However, prevention of excessive hypnosis is probably the most beneficial outcome of using such devices during TIVA.[6]

Hannam et al compared the hemodynamic profiles of etomidate and propofol for the induction of anesthesia in cardiac surgery and concluded that etomidate provides superior hemodynamic stability to propofol.[7] However, a reduction of 50% of the infused volume using the 2% formulation is possible and may be preferable for the maintenance of anesthesia in patients in whom a larger lipid load might be considered undesirable.[8]

Interindividual variability in pharmacodynamic response represents a more challenging aspect of using TIVA. Adequate training of the clinician is essential and close clinical monitoring of the patient remains an important part of the anesthetist's role. With wide popularity of minimally invasive/robotic cardiac surgery along with fast tracking in cardiac surgery, the role of TIVA is going to become even more significant.

Conflict of Interest

None.

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