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Transesophageal Echocardiography (TEE) in Cardiac Anesthesia: A Clinical Guide

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Introduction

Transesophageal Echocardiography (TEE) has become an indispensable tool in cardiac anesthesia, offering real-time, high-resolution imaging of the heart and great vessels that aids in diagnosis, monitoring and surgical decision-making. By placing an ultrasound probe in the esophagus, TEE provides unparalleled views of cardiac structures without interference from lungs or ribs, making it superior to transthoracic echocardiography during operative procedures. TEE is particularly valuable in valve surgeries, congenital heart defect repairs, aortic surgeries and coronary artery bypass grafting, where dynamic assessment of cardiac function and anatomic integrity is critical. Its use allows anesthesiologists to assess ventricular performance, valvular competence, preload status and the effectiveness of surgical repairs in real time. TEE is now considered standard practice in many cardiac surgical centers and is strongly recommended by professional societies such as the American Society of Anesthesiologists and the Society of Cardiovascular Anesthesiologists [1].

Description

Basic and advanced TEE certifications have been developed to ensure practitioners possess the skills necessary to interpret complex images accurately. The 20 standard TEE views, including mid-esophageal, transgastric and deep transgastric perspectives, form the foundation of comprehensive cardiac assessment during surgery. TEE also assists in guiding fluid therapy, evaluating intracardiac shunts and identifying sources of embolism or structural abnormalities not visible through other means. Furthermore, TEE plays a critical role during weaning from cardiopulmonary bypass, helping detect myocardial dysfunction, residual shunts, or valvular lesions that require immediate correction. Anesthesiologists trained in TEE can work closely with cardiac surgeons to facilitate real-time decision-making, reduce intraoperative complications and improve postoperative outcomes. As a diagnostic modality that combines portability, immediacy and versatility, TEE has reshaped the landscape of intraoperative cardiovascular care. Its growing integration into perioperative practice reflects a broader shift toward image-guided anesthesia and precision monitoring [2].

TEE enhances the anesthesiologist's ability to assess hemodynamic status with greater accuracy than conventional monitoring tools alone. Left and right ventricular function can be continuously visualized and quantified using TEE, enabling clinicians to detect subtle changes in contractility, wall motion and chamber volumes. Doppler imaging allows precise evaluation of blood flow patterns, pressure gradients and valve regurgitation or stenosis, which are essential in planning surgical intervention or optimizing anesthetic management. For example, intraoperative detection of left ventricular outflow tract obstruction or dynamic mitral regurgitation can significantly alter surgical and pharmacologic strategies. In cases of hemodynamic instability, TEE can differentiate between causes such as tamponade, hypovolemia, right heart failure, or dynamic left ventricular obstruction, allowing for targeted intervention. TEE is also invaluable in assessing prosthetic valve function, confirming the adequacy of valve seating and identifying paravalvular leaks that may require immediate revision. In thoracic aortic procedures, TEE provides detailed views of the ascending aorta, aortic arch and descending aorta, facilitating identification of dissection flaps, aneurysms and cannulation sites. During heart transplantation or ventricular assist device implantation, TEE aids in positioning and function verification of devices, ensuring effective cardiac support. Moreover, TEE has found increasing use in non-cardiac surgeries involving high-risk patients, particularly those with structural heart disease or undergoing major vascular procedures. The utility of TEE extends into interventional cardiology suites where anesthesiologists collaborate with cardiologists in structural heart interventions such as Transcatheter Aortic Valve Replacement (TAVR) and left atrial appendage occlusion. In these scenarios, TEE serves as a critical guide for device placement and real-time complication detection. With its ability to transform hemodynamic interpretation from inference to direct visualization, TEE has significantly elevated the standards of perioperative cardiovascular care [3].

Proper training and certification are essential for safe and effective use of TEE in the perioperative setting. TEE is a semi-invasive procedure with risks such as esophageal trauma, bleeding, or aspiration if not performed skillfully. Pre-procedural evaluation should include review of contraindications such as esophageal varices, strictures, or recent gastrointestinal surgery. The learning curve for mastering TEE is considerable, involving detailed knowledge of cardiac anatomy, physics of ultrasound, probe manipulation and interpretation of dynamic images. Standardized training pathways include simulation-based learning, supervised clinical practice and competency-based assessments culminating in board certification. The Basic PTEeXAM and Advanced PTEeXAM offered by the National Board of Echocardiography ensure standardized competence among anesthesiologists and intensivists who utilize TEE. In the operating room, probe insertion and handling must be done under aseptic conditions, with continuous monitoring for patient tolerance and procedural complications. Anesthesiologists must also be proficient in acquiring and interpreting the 20 standard views, recognizing artifacts and integrating findings with clinical and surgical data. Documentation and archiving of TEE images form part of quality assurance and medico-legal accountability. The emergence of Three-Dimensional (3D) TEE has further enhanced spatial visualization of cardiac structures and dynamic function, particularly useful in valve repair assessment and device placement. As ultrasound technology evolves, anesthesiologists will increasingly rely on digital integration, automated measurements and AI-supported diagnostics to refine their practice. Maintaining certification through continued education and practice review is essential to ensuring the high standards of perioperative TEE application. Institutional support, including access to equipment, expert mentorship and structured learning programs, is necessary to foster the next generation of cardiac anesthesiologists proficient in echocardiography [4-5].

Conclusion

The evolution of TEE is emblematic of broader trends in anesthesiology toward real-time, image-guided, precision medicine. Anesthesiologists must

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stay abreast of these developments to fully harness TEE's diagnostic and therapeutic potential in cardiovascular care. Ultimately, TEE not only enhances intraoperative safety and outcomes but also redefines the role of anesthesiologists as perioperative cardiovascular consultants. Its integration into cardiac anesthesia reflects the convergence of technology, physiology and clinical acumen, guiding modern practice toward more informed, responsive and patient-centered care. As capabilities expand, TEE will remain a cornerstone in the management of patients undergoing cardiac and high-risk surgeries.

Acknowledgment

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Conflict of Interest

None.

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