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Transesophageal Echocardiography (TEE) in Cardiac Surgery: Complications, Limitations, and Clinical Considerations

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Abstract:

- ***Background***

Transesophageal echocardiography (TEE) has become an indispensable diagnostic and monitoring tool in cardiac surgery, yet its semi-invasive nature is associated with complications and limitations. Understanding these risks is crucial for safe clinical practice.

- ***Objective***

To review the potential complications, contraindications, limitations, and pitfalls of TEE in cardiac surgery and to provide a balanced appraisal of its utility in perioperative management.

- ***Methods***

Literature-based review of complications, contraindications, and limitations related to TEE, supported by evidence from large case series and guideline documents. Clinical data were synthesized from key published studies and institutional experiences.

- ***Results***

Major complications of TEE are rare, ranging from 0.2% to 0.5% in diagnostic settings, with mortality below 0.01%. Intraoperative use increases complication risk (0.2–1.2%), including esophageal trauma, arrhythmias, airway obstruction, and hemodynamic compromise. Pediatric patients present additional risks due to anatomical constraints. Contraindications include esophageal pathologies and recent upper GI surgery. Limitations include restricted visualization of certain cardiac structures and artifacts that may mimic pathology.

- ***Conclusion***

Despite its risks, TEE remains an essential perioperative tool in cardiac surgery. Awareness of its complications and limitations allows clinicians to optimize patient safety while benefiting from its diagnostic power.

Keywords: *Transesophageal Echocardiography, Cardiac Surgery, Complications, Limitations, Perioperative Monitoring.*

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I. INTRODUCTION

Transesophageal echocardiography (TEE) has become a cornerstone of perioperative monitoring in cardiac surgery. Its ability to provide real-time imaging of cardiac structures, hemodynamic assessment, and guidance for surgical decision-making has revolutionized intraoperative management. [1,2] Unlike transthoracic echocardiography, TEE bypasses thoracic wall and pulmonary interference, offering superior imaging quality. [4] However, the semi-invasive nature of TEE, involving the insertion of a probe into the esophagus, carries inherent risks of trauma, hemodynamic compromise, and airway complications.[5-7] As cardiac surgery frequently involves anticoagulation and complex physiology, the risks may be magnified in this setting.

This review article aims to systematically explore the complications, contraindications, and limitations of TEE in cardiac surgery, contextualized with evidence from large studies and guidelines. Understanding these aspects is critical to ensure safe practice and to balance its diagnostic utility against potential harm.

II. METHODS

This article is based on a narrative literature review of published studies, clinical guidelines, and large case series pertaining to TEE in cardiac surgery. Relevant peer-reviewed articles were identified using PubMed and Google Scholar, focusing on studies that addressed perioperative complications, contraindications, limitations, and artifacts. Key references include large multicenter case series, guideline statements, and observational reports. No new patient data were collected for this study.

III. RESULTS

The complications of TEE can be categorized into mechanical, airway-related, cardiovascular, gastrointestinal, and pediatric-specific complications. Mechanical complications include dental injury, esophageal ulceration, perforation, hematoma, and dysphagia. Airway-related complications range from accidental tracheal extubation, airway obstruction, hypoxia, to distraction from anesthetic care. Cardiovascular complications such as ventricular arrhythmias, atrioventricular block, and transient atrial fibrillation have been reported, often attributed to catecholamine surges during probe insertion.

Large-scale studies have reported overall complication rates ranging from 0.2% to 1.2%, with mortality below 0.01%. For instance, Hilberath et al. reported major complications in 0.2–0.5% of patients, while Kallmeyer et al. documented 0.02% morbidity among 7,200 cardiac surgical patients. Min et al. found an overall complication rate up to 2.3% in fully anticoagulated patients.

Pediatric patients present unique risks, with a 3.2% complication rate in one large retrospective study, primarily related to airway obstruction, vascular compression, and probe insertion failure.

Contraindications to TEE are divided into absolute and relative categories. Absolute contraindications include esophageal perforation, strictures, tumors, active upper GI bleeding, recent GI surgery, and esophagectomy. Relative contraindications encompass restricted cervical mobility, prior radiation to chest, hiatal hernia, esophagitis, and peptic ulcer disease.

TEE has several limitations in assessing specific cardiac lesions. For instance, imaging of the distal ascending aorta and right ventricular outflow tract is limited. In valvular pathology, measurement errors due to flow dependency, jet geometry, and artifacts may lead to under- or overestimation of severity. Pitfalls include misdiagnosis of normal anatomical variants (e.g., crista terminalis, Coumadin ridge) as pathological findings. Artifacts such as acoustic shadowing, reverberation, and side lobe artifacts can further complicate interpretation. [2310]

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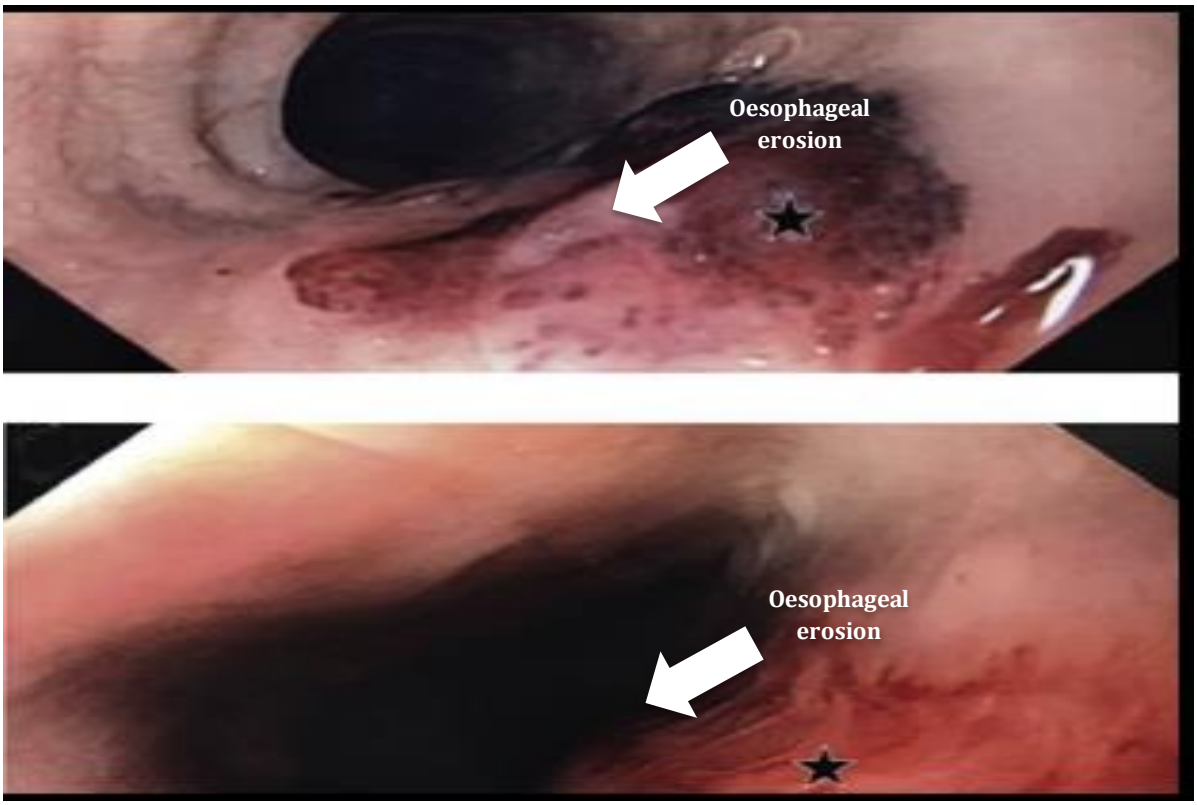

Fig 1: Esophageal Mucosal Erosion.

Fig 2: Mid-Esophageal 4-Chamber View Showing Partially Visualized Left Atrium (LA) and Left Ventricle (LV).

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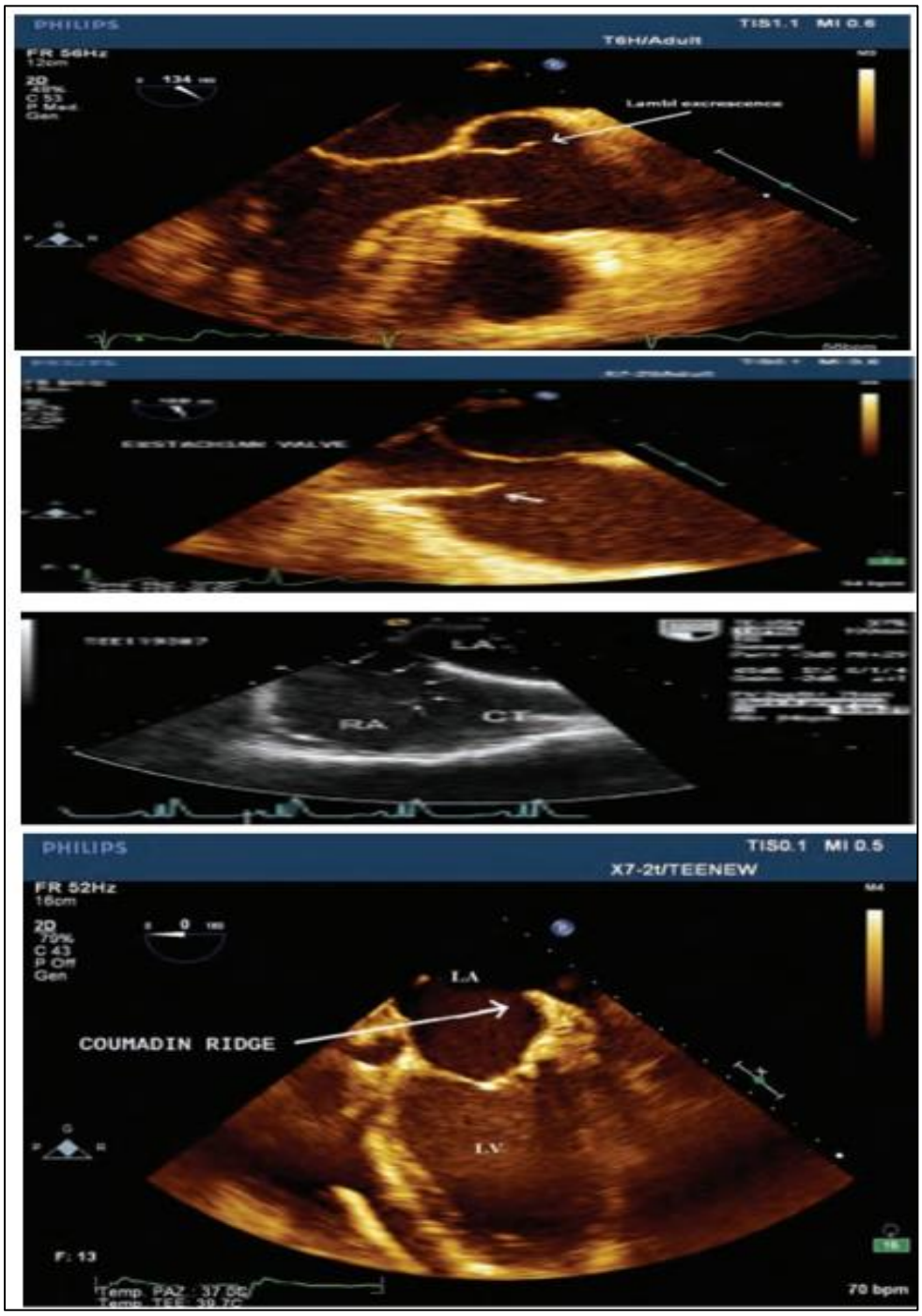

Fig 3: Artefacts images in Transesophageal Echocardiography.

IV. DISCUSSION

TEE has established itself as an indispensable intraoperative imaging modality in cardiac surgery, with clear advantages in guiding surgical repair, monitoring cardiac function, and detecting complications. However, its semi-invasive nature necessitates a careful appraisal of risks versus benefits.

The reported complication rates, although low, emphasize that TEE is not without risk. Esophageal injury, oropharyngeal trauma, and arrhythmias underscore the importance of appropriate patient selection and operator expertise. [2,4,7] Absolute contraindications must be respected, and relative contraindications carefully weighed. Pediatric patients, due to anatomical and physiological vulnerabilities, require special consideration and specialized probe sizes. [8]

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Limitations of TEE in evaluating certain pathologies highlight the need for complementary imaging modalities such as epiaortic echocardiography, cardiac MRI, or CT angiography in specific cases. Furthermore, artifacts and pitfalls demand cautious interpretation to avoid misdiagnosis[9]

Despite these challenges, the overall safety profile and diagnostic yield of TEE justify its widespread use in perioperative care. Continuous operator training, adherence to guidelines, and technological advancements are expected to further reduce complication rates and improve diagnostic accuracy[10]

V. CONCLUSION

Transesophageal echocardiography remains an essential tool in the armamentarium of cardiac anesthesiologists and surgeons. While complications and limitations exist, judicious use, careful patient selection, and operator expertise can mitigate these risks. The balance between its diagnostic utility and potential hazards strongly favors its routine use in cardiac surgery, provided contraindications are respected and limitations acknowledged.

- *Conflicts of Interest*

  The authors declare no conflicts of interest.

- *Funding*

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