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ORIGINAL ARTICLE

Safety of transesophageal echocardiography (TEE)-A 10 year experience at a tertiary care cardiac institute.

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ABSTRACT… Objective: To assess the safety profile, major and minor complications, and risk mitigation strategies associated with TEE. **Study Design:** Retrospective observational study. **Setting:** Rehmat-ul-lil-Alameen postgraduate institute of Cardiology (RAIC), PESSI, Lahore. **Period:** Ten-year data focusing on TEE procedures (September 2014 to March 2025) was utilized. **Methods:** A total of 358 procedures were studied, carried out by 02 consultant cardiologists. In addition to demographic data, variables including indications and complications of TEE were studied. Statistical analysis was performed using SPSS Version 22. **Results:** TEE is proved to be generally safe, with major complications occurring in 0.2% of cases. There was no procedure related mortality. Minor complications, such as odynophagia, throat discomfort and minor pharyngeal bleed, were also uncommon (5.02%). The most common indication of diagnostic TEE was assessment of atrial septal defect 102(31.0%) while in case of intraoperative TEE, the most common indication was minimally invasive cardiac surgery 20(66.0%). The most common TEE complication (minor) was odynophagia that occurred in 1.3% of the population. **Conclusion:** While TEE has an excellent safety profile, clinicians must remain vigilant to prevent and promptly manage complications. Proper patient selection, adherence to guidelines, and operator expertise are crucial for ensuring patient safety. Future advancements in probe design and sedation protocols may further reduce risks.

Key words: Complications, Esophageal Perforation, Procedural Safety, Transesophageal Echocardiography (TEE).

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INTRODUCTION

Transesophageal echocardiography (TEE) has revolutionized cardiovascular diagnostics by providing unparalleled imaging of cardiac structures, surpassing the capabilities of conventional transthoracic echocardiography (TTE). By positioning an ultrasound probe within the esophagus, TEE offers enhanced visualization of posterior cardiac anatomy, making it indispensable for evaluating valvular pathology, intracardiac shunt, intracardiac thrombi, endocarditis, and aortic dissection.[1] Its utility extends beyond diagnostics to perioperative monitoring during cardiac surgery and structural interventions, where real-time imaging guides clinical decision-making.[2]

Despite its widespread use and clinical benefits, TEE remains an invasive procedure that carries inherent risks. The insertion of a probe through the oropharynx and esophagus can lead to mechanical trauma, while sedation—often required for patient comfort—introduces additional physiological risks.[3] Although major complications such as esophageal perforation or severe bleeding are rare (<1%), their consequences can be life-threatening.[4] More commonly, minor complications such as oropharyngeal injury, transient hypoxia, or arrhythmias may occur, emphasizing the need for meticulous procedural technique and patient selection.[5]

Given the expanding indications for TEE, including its growing use in critically ill and elderly patients with multiple comorbidities, a thorough understanding of its safety profile is essential. Current guidelines from the American Society of Echocardiography (ASE) and the Society of Cardiovascular Anesthesiologists (SCA) provide standardized protocols to minimize risks.[1] However, variations in operator experience, patient factors, and procedural settings (e.g., emergency vs. elective TEE) can influence complication rates.

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This article reviews the safety and complications associated with TEE, drawing upon large-scale clinical studies and societal recommendations. By synthesizing current evidence, this study aims to enhance clinician awareness and optimize patient outcomes in the performance of TEE.

METHODS

This Retrospective observational study (Single Centre experience) was conducted at Rehmat-ul-lil-Alameen Postgraduate Institute of Cardiology (RAIC), PESSI.

A total of 358 patients who underwent TEE were included in the study, it included both genders and all ages.

Data Source / Measurement

Data was collected from the hospital database after obtaining approval form the Institutional review board & Ethical committee (IRB&EC) (RAIC PESSI/Ett/2025/2893). TEE reports and patients' data notes (Pre, Intra & Postprocedural) were reviewed. Ten years (+) data was assessed i.e., from September 2014 to March 2025.

The variables studied included demographic data such as age and gender, indications, diagnosis and complications of TEE.

Bias

Efforts were made to minimize the bias by ensuring complete data collection avoiding selection & informational bias.

All 358 patients who underwent TEE were included in the study to ensure adequate statistical power.

Quantitative valuables such as age, were described using measures of central tendency (Mean) and dispersion (Standard deviation).

Statistical Methods

Statistical analysis was performed using SPSS statistical Version 22. Descriptive statistics were used to summarize the data, including calculations of means and standard deviations for continuous variables and percentage for categorical valuables.

All patients were assessed pre-procedure by the consultant cardiologist carrying out the procedure. All TEE procedure were carried out by two 2 operators (Consultant cardiologists: Assistant/Associate professor cardiology). All patients had their labs done one-two days before the procedure including complete blood count (CBC), coagulation profile and viral markers. All patients were kept NPO for 6 hours before the procedure.

Written informed consent was taken from all patients on the day of procedure. Hemodynamic status was documented. Eleven (3.07%) patients were recorded as hemodynamically unstable. IV access was taken in every patient. Supplemental oxygen was used in 25(7%) patients. TEE were carried out for OPD patients in echocardiography room with patients in left lateral decubitus position. Local anesthesia (2% lignocaine spray) was used in all patients (except intraoperative TEE). No sedation was used in patients except in 04 patients. Out of these four, Midazolam IV was used in three patients while ketamine was used in fourth patient who was highly non-cooperative. Patient's pulse, BP, ECG rhythm and oxygen saturation were monitored during the procedure. Probe (Multiplane Toshiba Model-PET-510 MA) was inserted through the bite block except in patients undergoing intraoperative TEE. TEE was done on Toshiba Aplio artida Machines-Model SSH 880CV.

Maximum duration of TEE procedure reported was 26 minutes. There were reported 05 difficult insertions-02 because of patient non-cooperation while 03 because of anatomical issues (short neck).

TEE was successful in 356 patients. Two patients pulled out the probe during the procedure (interrupted procedure). No TEE was done as a part of percutaneous intervention.

All patients were observed post-procedure for at least 04 hours with vital monitoring and symptoms. All outdoor patients were discharged on the same day except one, who developed pulmonary oedema. He was discharged on next day in stable condition.

RESULTS

A total of 358 TEE procedures were done during

the period; out of 358, 328 were diagnostic TEE procedure while 30 were intraoperative TEE. 175 (49%) were male patients while 183 (51%) were female patients. Average age among male patients was 43.75 ± 9.6 years while average age among female patients was 38.3 ± 11.2 years.

The most common indication of diagnostic TEE was assessment of atrial septal defect 102(31.0%), followed by Prosthetic valve assessment 71(21.6%). The most common indication of Intraoperative TEE was MICS (minimally invasive cardiac surgery) 20(66.0%).

The overall incidence of major complications was 0.2% while overall incidence of minor complications was 5.02%. There was no procedure related mortality. The most common TEE complication (minor) was odynophagia that occurred in 1.3% of the population.

Other complications included non-specific sore throat 04(1.1%), unsuccessful probe insertion 02(0.5%), interrupted procedure 02(0.5%), minor pharyngeal bleed 02(0.5%), self-limiting arrhythmia 01(0.2%), dysphagia 01(0.2%) and transient hoarseness 01(0.2%).

Only one major complication occurred i.e., patient develop pulmonary edema during the procedure. Was identified by drop in oxygen saturation and tachypnoea. He was a diagnosed case of aortic regurgitation. TEE was being done for assessing severity of aortic regurgitation & anatomy of aortic valve. Procedure was abandoned immediately. He was propped up and treated on lines of pulmonary oedema. He was shifted to CCU. Stabilized and was discharged in stable condition next day.

DISCUSSION

Transesophageal echocardiography (TEE) is a cornerstone of modern cardiovascular imaging, offering superior visualization of cardiac structures compared to transthoracic echocardiography (TTE). However, as an invasive procedure, it carries inherent risks that must be carefully managed.[6] This discussion examines the safety profile of TEE, analyzes reported complications, and highlights strategies to minimize adverse events.

TABLE-I

Baseline characteristics	
Total Number	358 (100%)
Gender	
Male	175(49%)
Female	183(51%)
AGE	
AVG AGE (Males)	43.75 ± 9.6
AVG AGE (Females)	38.3 ± 11.2

TABLE-II

Indications of TEE

Diagnostic TEE (328; 91%)

Indications	Number
1. ASD assessment	102(31.0%)
2. Prosthetic valve assessment	71(21.6%)
3. Dilated Right Heart	56(17.0%)
4. Assess of Aortic/mitral regurgitation	25(7.62%)
5. Pre – PTMC	35(10.6%)
6. Assessment of Aortic Valve	13(3.9%)
7. Assessment of Mitral Valve	11(3.3%)
8. Assessment of Pulmonary Hypertension	11(3.3%)
9. VSD (ventricular septal defect)	02(0.6%)
10. Ruptured Sinus of Valsalva (RSOV)	02(0.6%)

Intraoperative TEE (30; 09%)

Indications	Numbers
1. Minimally Invasive Cardiac Surgery-MICS	20(66.0%)
2. Mitral valve assessment/repair	07(2.1%)
3. Aortic Valve assessment/repair	02(0.6%)
4. VSD repair	01(0.3%)

Large-scale studies and clinical guidelines confirm that TEE is generally safe when performed by trained operators. The incidence of major complications is low (<1%), with mortality being exceedingly rare (≤0.01%).[2,3] The procedure's safety is attributed to: Standardized protocols (e.g., ASE/SCA guidelines),[1,7] Proper patient selection (avoiding high-risk individuals) & Advances in probe technology (smaller, more flexible designs).

Nevertheless, the invasive nature of TEE means that minor complications (e.g., odynophagia, throat discomfort, transient hypoxia) can occur, necessitating vigilance before, during, and after the procedure.

TABLE-III	
Complications of TEE	
Major Complications	**Number**
1. Death	00(0.0%)
2. Esophageal perforation	00(0.0%)
3. Major bleed	00(0.0%)
4. Severe respiratory event	00(0.0%)
5. Ventricular arrythmia	00(0.0%)
6. Vocal cord injury	00(0.0%)
7. Pulmonary oedema/Heart Failure	01(0.2%)
8. Tracheal intubation	00(0.0%)
Total	**01(0.2%)**
Minor Complications	**Number**
1. Dysphagia.	01(0.2%)
2. Odynophagia	05(1.3%)
3. Sore throat	04(1.1%)
4. Transient hypoxia	00(0.0%)
5. Dental trauma	00(0.0%)
6. Arrythmia (Self- limited, atrial)	01(0.2%)
7. Minor pharyngeal bleed	02(0.5%)
8. Lip injury	00(0.0%)
9. Oral or pharyngeal trauma	00(0.0%)
10. Vasovagal reaction	00(0.0%)
11. Allergic reaction	00(0.0%)
12. Laryngeal Spasm	00(0.0%)
13. Bronchospasm	00(0.0%)
14. Transient Hoarseness	01(0.2%)
15. Infections	00(0.0%)
16. Unsuccessful probe Insertion	02(0.5%)
17. Procedure interruption	02(0.5%)
Total	**18(5.02%)**

The overall incidence of major complications in our study was 0.2% while overall incidence of minor complications was 5.02%. There was no procedure related mortality. The most common TEE complication (minor) was odynophagia that occurred in 1.3% of the population. Other complications included non-specific sore throat 04(1.1%), unsuccessful probe insertion 02(0.5%), interrupted procedure 02(0.5%), minor pharyngeal bleed 02(0.5%), self-limiting arrhythmia 01(0.2%), dysphagia 01(0.2%) and transient hoarseness 01(0.2%). Only one major complication occurred i.e., patient develop pulmonary edema during the procedure.

Analysis of Complications in different studies show that gastrointestinal Injuries are the most feared ones. Out of these the most feared complication is esophageal perforation, though its incidence is extremely low (0.01–0.03%).[1,4] Risk factors include: structural abnormalities (strictures, diverticula, tumors), excessive probe manipulation (especially in uncooperative patients) & recent esophageal surgery or radiation. No such complication was recorded in our study.

In a single center case series of 10,000 consecutive patients[8], only one case of hypopharyngeal perforation (0.01%), 2 cases of cervical esophageal perforation (0.02%), and no cases of gastric perforation (0%) were reported. No fatalities (0%) were reported.

In a study conducted by Lennon MJ et al[9] major GI complications were more common in intraoperative TEE.

Minor mucosal injuries (e.g., abrasions, Mallory-Weiss tears) are more common but rarely clinically significant. Post-procedure dysphagia or odynophagia should prompt evaluation for deeper injury. Post-procedure record of patients who reported odynophagia and dysphagia in our study showed that although symptoms were transient but they were serially evaluated and followed up. Nothing serious could be traced.

Cardiovascular Events are also reported rarely & include: Arrhythmias: Atrial fibrillation or ventricular ectopy may occur due to mechanical stimulation. Vasovagal reactions: Can lead to bradycardia or hypotension, particularly in anxious patients. Rare cases of myocardial ischemia have been reported in critically ill patients. One patient had atrial arrythmia in our study. He had transient atrial fibrillation that resolved spontaneously once probe was taken out.

Respiratory complications including laryngeal injury are also reported in literature. No such complication recorded in our pool of patients.

Other reported complications are: Dental damage (loose teeth, crowns): can be mitigated with mouthguard use. No such complication recorded in our patients. Bleeding: Rare but possible in

anticoagulated patients or those with esophageal varices. Usually minor and treated with conservative measures. No case of major bleed recorded in our patients. Minor pharyngeal bleed was reported in 02(0.5%) patients that settled with conservative measures.

Even in critically ill & hemodynamically unstable patients, the mortality is very rare. In a study of 77 critically ill patients[10], the mortality was nil. In our study eleven (3.07%) patients were hemodynamically unstable. Mortality in our study was also nil.

To avoid complications, risk mitigation strategies should be used to avoid complications. That include: Pre-Procedure Assessment: Exclude contraindications (e.g., esophageal pathology, unstable cervical spine). Evaluate coagulation status in patients on anticoagulants. Intraprocedural Vigilance: Use the smallest feasible probe size. Avoid excessive force during insertion. Maintain continuous hemodynamic and oxygen saturation monitoring. Post-Procedure Monitoring: Observe for delayed complications (hematemesis, chest pain). Withhold oral intake until gag reflex returns (typically 1–2 hours post-sedation).

While TEE provides unparalleled cardiac imaging, noninvasive alternatives (e.g., cardiac MRI, CT angiography) may be preferable in high-risk patients. However, TEE remains indispensable for intraoperative monitoring and detecting conditions like endocarditis, prosthetic valve dysfunction and Atrial septal defects. It is reliably used for assessment of ASD for device closure.[11]

LIMITATIONS

This study has several limitations including its reliance on data from a single center which may limit generalizability of the findings. Secondly, the retrospective design of the study introduces inherent bias. Additionally, the sample size may not have been enough to detect all the complications. These limitations may be addressed through larger multicenter studies with prospective designs.

CONCLUSION

TEE is a highly valuable diagnostic tool with a strong safety record when performed appropriately. Most complications are minor and preventable with meticulous technique and patient selection. Clinicians must remain aware of rare but serious risks (e.g., perforation, aspiration) and adhere to established guidelines to ensure optimal outcomes. Future advancements in probe technology, operator expertise and sedation protocols may further enhance safety.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Azmat Ehsan Qureshi:** Concept and design, data acquisition & interpretation, drafting, approval of final version.
2	**Najeeb Ullah:** Data acquisition and interpretation, drafting, approval of final version.
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