

Safety of Transesophageal Echocardiography in Patients with Prior Chest or Neck Irradiation. A Retrospective Cohort Study.

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Abstract

Aims: Prior chest and neck irradiation are considered relative contraindications to transesophageal echocardiography. The foundation of such a warning is theoretical and, at best anecdotal. We intended to retrospectively examine the safety of transesophageal echocardiography in this cohort.

Methods and results: Utilizing the relevant International Classification of Diseases (ICD) and Current Procedural Terminology (CPT) codes, patients older than 18 years old with prior chest or neck irradiation therapy who underwent transesophageal echocardiography (TEE) at our institution in the period between 2004-2020 were identified and considered for inclusion. 31 patients, who underwent a total of 49 TEE studies, were included in the final analysis. In a 30 day follow up period following the index TEE, no significant complications occurred in any of the patients.

Conclusions: In this small cohort of patients with prior chest or neck irradiation therapy, transesophageal echocardiography was carried out safely and successfully.

Background

Transesophageal echocardiography (TEE) is an invaluable tool in evaluating cardiac structure and function with widespread applications in today's medical practice. It represents an important supplemental imaging modality to transthoracic echocardiography with superior accuracy in diagnosing certain valvular pathologies, intracardiac infections, and aortic pathology (1, 2). It also offers an alternative in patients with poor transthoracic imaging windows. The safety of TEE has been established with a very low risk of serious complications (1, 3, 4). Neck and mediastinal irradiation are considered a relative contraindication to TEE (5) due to a concern of radiation-induced tissue abnormalities that increase the risk of mechanical injuries in this cohort. However, the basis for such recommendation lacks, as does data on the safety of TEE in this patient population. We intended to investigate the safety and feasibility of TEE in patients with prior chest or neck irradiation.

Methods

Patient selection

Patients older than 18 years of age with a history of prior chest or neck irradiation and who have undergone transesophageal echocardiography at Geisinger Medical Center in the period between January 2004 and January 2020 were considered for inclusion. The relevant International Classification of Diseases (ICD) and Current Procedural Terminology (CPT) codes were used for data extraction. Patients who underwent upper gastrointestinal procedures within 4 weeks of the index TEE (nasogastric, orogastric and percutaneous gastrostomy, upper gastrointestinal endoscopy, esophageal stenting, esophageal and gastric surgeries), as well as patients with no 30-day, follow up (defined as the lack of medical encounters beyond the 30-day follow up period) were excluded.

Outcomes

The electronic records (clinical notes and radiological studies) were reviewed for occurrence of significant mechanical injuries to the pharynx, esophagus, and stomach defined as significant bleeding (more than 1 gram drop in hemoglobin), injuries requiring surgical repair or endoscopic intervention, hospital stay for observation, and death within 30 days of the index TEE.

Statistical analysis

Continuous variables are described via the use of mean and standard deviations from the mean, whereas categorical variables are described as proportions.

Results

Patient characteristics

6,752 TEE studies were done in the period between 1/2004 to 9/2019. Of these, 52 studies were done in 34 patients with prior chest or neck irradiation. Patients were identified utilizing the appropriate CPT and ICD codes. 2 patients were excluded due to the inability to locate the TEE information, and 1 patient was excluded due to the inability to confirm if radiation treatment was ever received. 31 patients, who underwent a total of 49 TEE examinations, were included in the final analysis (Fig. 1). The baseline characteristics are shown in Table 1.

Table 1

Baseline characteristics. SD: standard deviation. TEE: transesophageal echocardiography. cGy: centigray.

Characteristic	
Mean (SD) age, year	71 (9.7)
Female, n (%)	25 (80)
Mean (SD) platelet count	21 K/uL (9.8)
Liver disease, n (%)	0 (0)
Systemic anticoagulation, n (%)	16 (51.6)
Dysphagia prior to TEE, n (%)	3 (9.6)
Mean (SD) time interval between radiation and TEE in years	8 (10)
Indication for TEE, n (%)	Intraoperative 24 (49), valve disease 15 (30), endocarditis 5 (10), intracardiac mass 3 (6), prior to cardioversion 2 (4).
Site of radiation therapy, n (%)	Breast 18 (58), mediastinum 5 (16), mantle 2 (6.4) lung 2 (6.4), larynx/tonsil 3 (10), chest wall 1 (3)
Mean (SD) total radiation dose in cGy ^a	5441 (1466)
Chemotherapy treatment, n (%)	15 (48)
Irradiation modality, n (%) ^b	External beam 24 (78), brachytherapy 1 (0.03)

a: data unavailable for 6 patients.

b: data unavailable for 6 patients.

18 (58%) of our patients were treated with radiation therapy for breast cancer. Of which, 5 (16%) patients had positive lymph node biopsies and thus received radiation to regional lymphatics (supraclavicular, internal mammary, or both). 8 (25.8%) patients received combined chemoradiation. Tangential field radiotherapy was the utilized radiation modality in 10 (32%) patients.

7 (22.5%) patients underwent mediastinal or mantle radiation. 5 of which underwent combined chemoradiation therapy. Figure 2 depicts the sites of radiation therapy in our cohort. Figure 3 shows the total radiation dose received among the study subjects.

Details of the radiation therapy were not available in 6 patients.

Outcomes

49 studies were successfully performed in 31 patients, with no occurrence of significant complications in the 30-day follow up period.

Discussion

Radiation therapy (RT) is an integral treatment modality for several malignancies. The ionizing effects of radiation damage the DNA leading to cell death (6). Although aimed at malignant cells, normal cells are also susceptible to the damaging effects of RT. Side effects of RT is dependent upon tissue sensitivity and proximity to the radiation source, cumulative radiation dose, and concomitant chemotherapy. Adverse effects of RT stems from acute tissue swelling, secondary malignancies, and the long-term sequelae of tissue fibrosis (7–9). Neck radiation is known to cause lymphedema and tissue fibrosis in the long term (10). The likelihood of radiation-induced esophageal injuries is influenced by the radiation modality, total radiation dose to the esophagus, concurrent chemotherapy, and pre-existing esophageal diseases (11–15). Radiation doses in excess of 40–50 Gray (Gy) correlate with esophagitis risk (16). Radiation-induced esophageal injuries are commonly graded using the Radiation Therapy Oncology Group (RTOG) and the European Organization for Research and Treatment of Cancer (EORTC) toxicity grading scale (17). In patients with non-small cell lung cancer (NSCLC) acute severe esophageal injuries had a reported incidence of 46% in one study (18) while only 3% had RTOG grade 3 late toxicity in another report (13). Esophageal strictures have been reported in pediatric patients, 10–15 years of age, after chest radiation for Hodgkin lymphoma (19, 20). The incidence of esophageal strictures in adults after radiotherapy for head and neck cancer was 3.3% in one report (21). NSCLC radiotherapy is also associated with the development of esophageal strictures (22).

The incidence of esophageal adverse effects with breast cancer radiotherapy is less well-studied. It is known, however, that there is an increased risk of esophageal cancer as second primary cancer in breast cancer survivors, and that risk is incremental with increasing radiation dose (23–25). Radiation doses to the esophagus are highest if supraclavicular and/or internal mammary lymph nodes were included in the treatment fields with a median dose of 25–38 Gy. Tangential fields resulted in significantly lower doses to the esophagus (less than 2 Gy) (24, 26).

The aforementioned late esophageal sequelae of radiation therapy pose a concern for higher risk of injuries with esophageal instrumentation, especially those done without direct visualization. Prior chest radiation is considered a relative contraindication to transesophageal echocardiography (5) however, the evidence supporting such recommendation is limited to case reports (27). In a meta-analysis of 22 studies, all perforations occurred in patients without perceivable risk factors (28). In another large single-center study, including 10,000 patients, 3 perforations occurred, none of which had risk factors, including chest radiation (29). Nevertheless, the safety of TEE in patients with prior chest radiation has never been systematically studied.

In our study 49 TEE examinations, in 31 patients, were performed successfully with no reported complications in a 30 day follow up period. The most frequent indication for TEE was intraoperative for

cardiac surgeries (Fig. 4). The median radiation dose was relatively high at 54 Gy (Fig. 3). The study included 16 patients with combined chemoradiation therapy, which infers a higher risk of esophageal adverse effects, none of which suffered significant complications.

The limitations of our study include a small sample size and possible selection bias, where only 3 patients (9.6%) had reported dysphagia/odynophagia. It is possible that patients with significant dysphagia were denied the procedure and can't be accounted for in our conclusion. Another limitation of the study is the inclusion of 12 patients with lymph node-negative breast cancer who may not have received a significant radiation dose to the esophagus given the use of tangential fields and the exclusion of regional lymphatics from the radiation field (24, 26).

Conclusion

In a small cohort of patients with prior chest or neck irradiation, transesophageal echocardiography may be done safely and successfully in well-screened patients. Although more investigations, including larger sample sizes, are needed to determine the risk more accurately, our study suggests that transesophageal echocardiography doesn't carry a high risk of complications in patients with prior chest or neck irradiation.

Abbreviations

ICD

international Classification of Diseases

CPT

current Procedural Terminology code

TEE

transesophageal echocardiography

RT

radiation therapy

Gy

Gray

cGy

centigray

RTOG

Radiation Therapy Oncology Group

EORTC

European Organization for Research and Treatment of Cancer

NSCLC

non-small cell lung cancer

Declarations

Ethics approval and consent to participate:

Our study was approved by Geisinger medical center institutional review board.

Consent for publication:

Not applicable.

Availability of data and materials:

The data that support the findings of this study are available from Geisinger research institute, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are, however, available from the authors upon reasonable request and with permission of Geisinger research institute.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions:

OM prepared the study's protocol, guided data extraction, reviewed individual charts, analyzed the data, and prepared the manuscript. AA supervised data analyses and assisted in preparing and proof-reading the manuscript. All authors read and approved the final manuscript.

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Figures

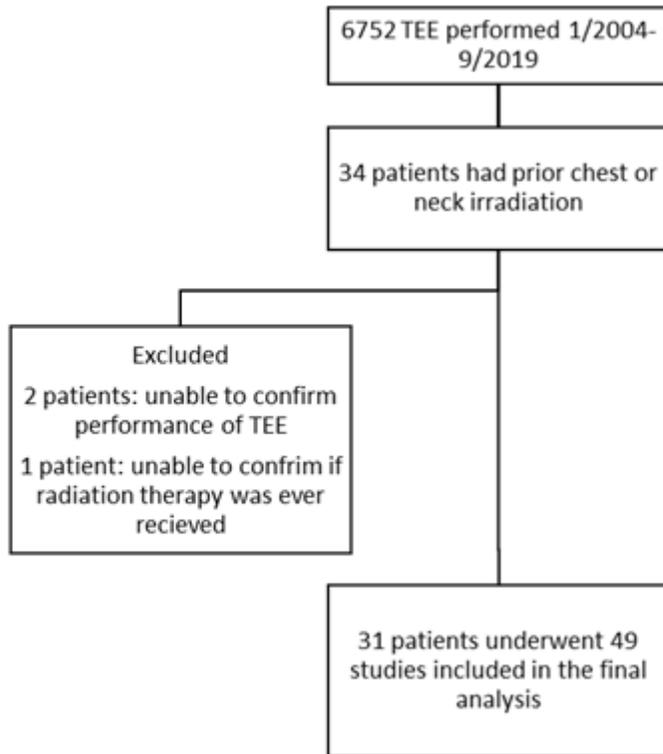


Figure 1

Patient selection and inclusion.

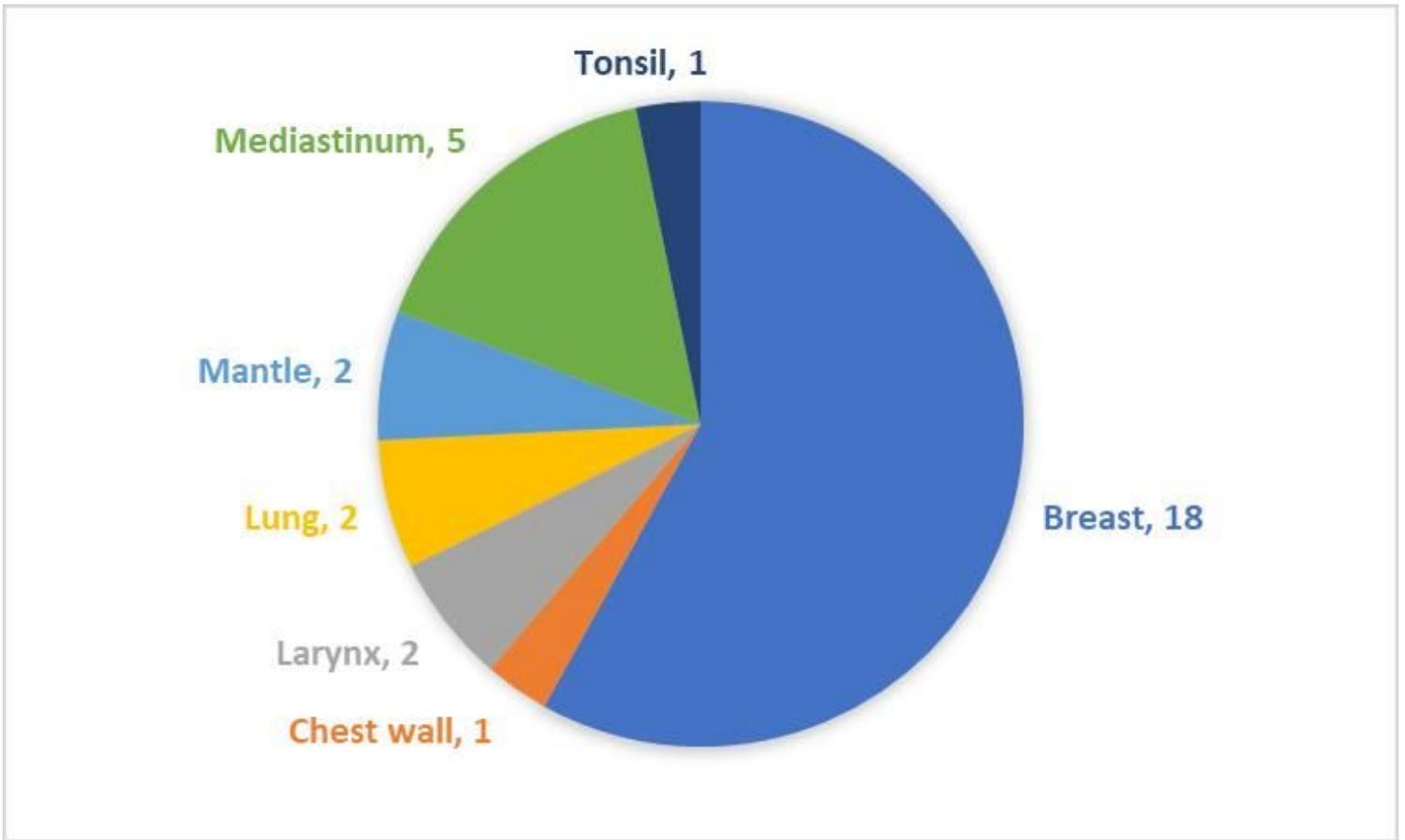


Figure 2

Sites of radiation therapy in the study patients.

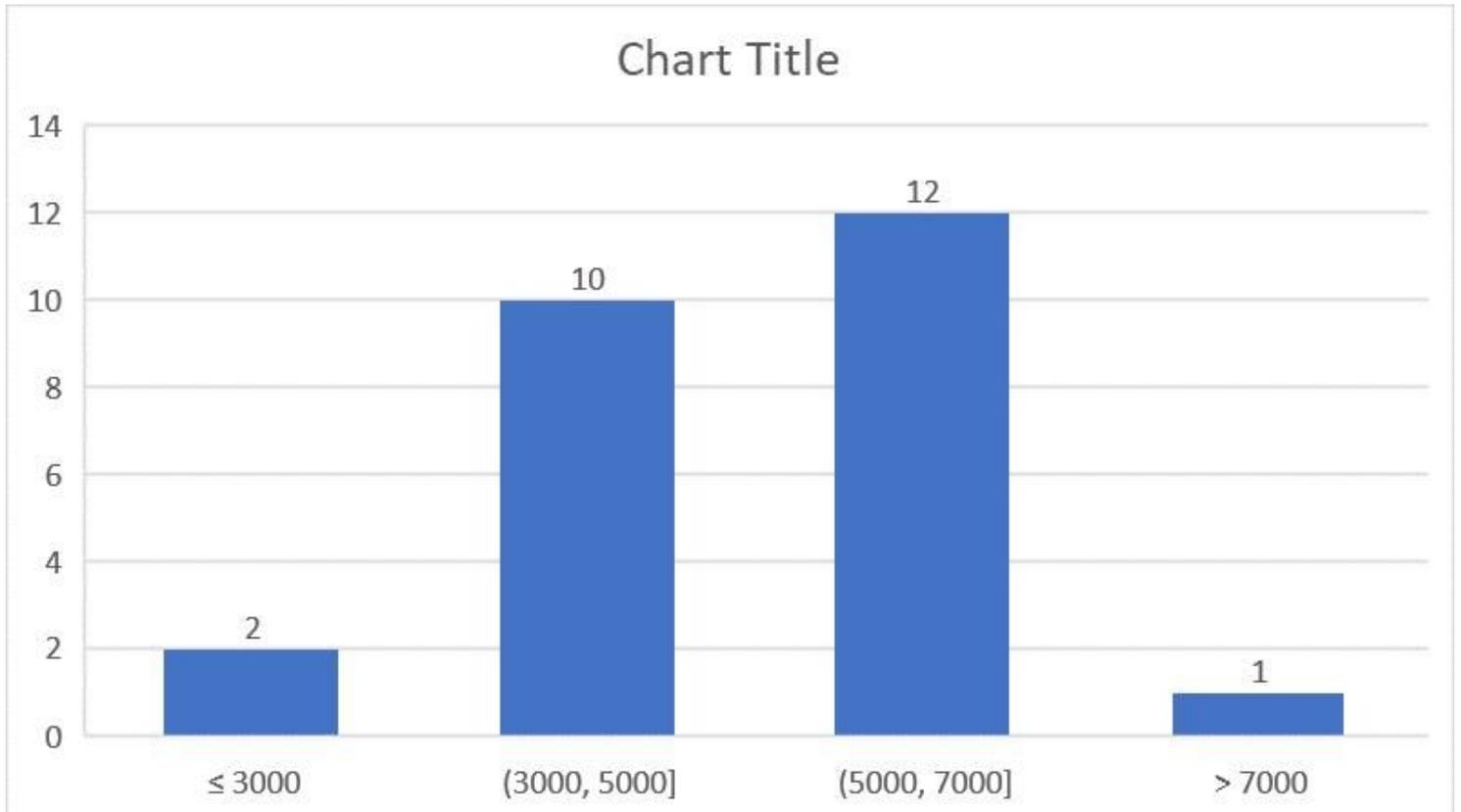


Figure 3

Total radiation dose in cGy received per patient in the study population.

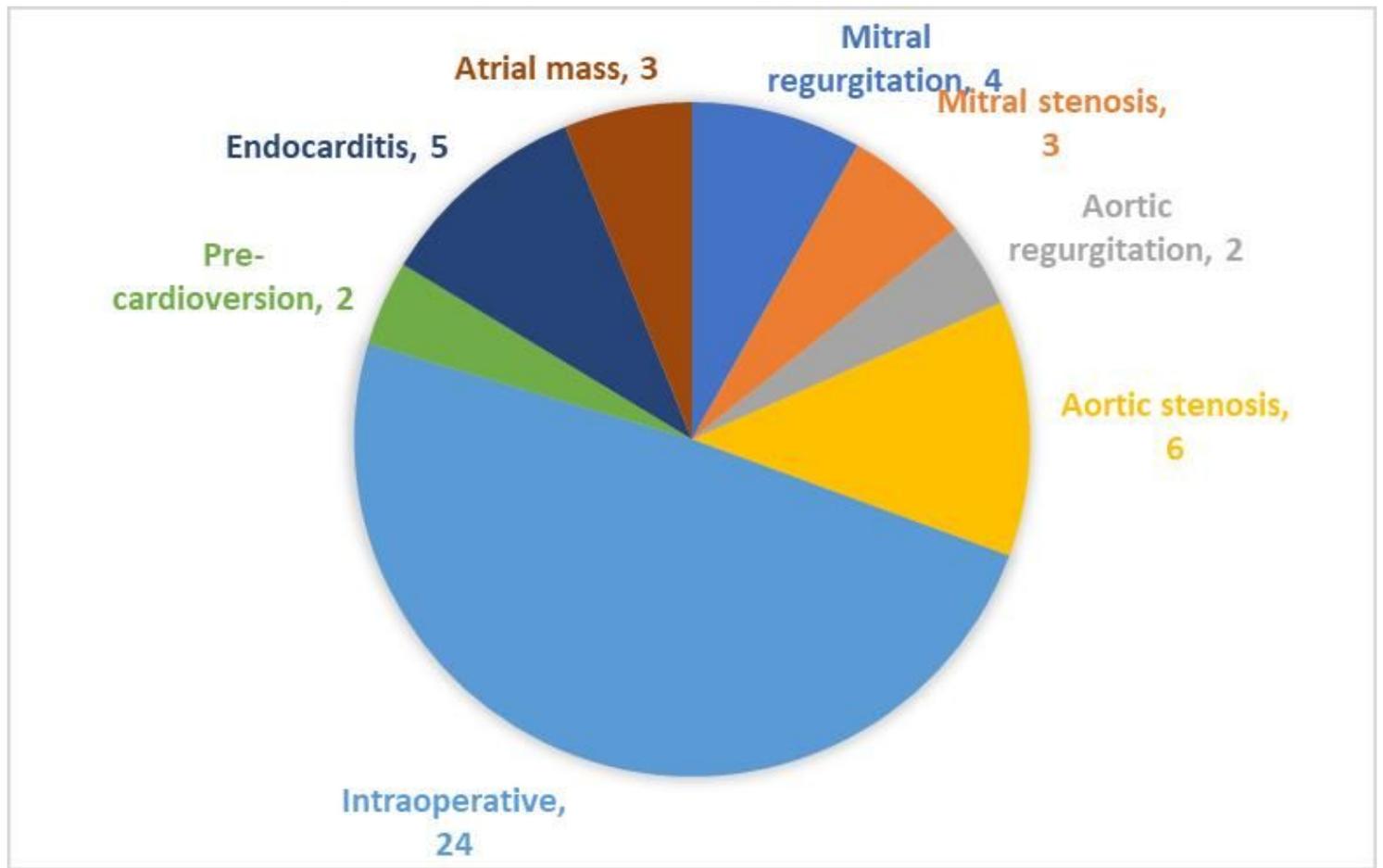


Figure 4

Indications for transesophageal echocardiography.

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