Original Research Paper

Volume - 16 | Issue - 04 | April - 2026 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Radio-Diagnosis

MULTIDETECTOR CT EVALUATION OF ACQUIRED TRACHEOESOPHAGEAL FISTULA: IMAGING FINDINGS FROM A TERTIARY CARE CENTRE IN NORTHEAST INDIA

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ABSTRACT Acquired tracheoesophageal fistula (TEF) represents an abnormal communication between the esophagus and the tracheobronchial tree and is associated with significant respiratory morbidity due to recurrent aspiration. In adults, the most common etiologies include advanced esophageal malignancy and corrosive ingestion. Early radiological identification is essential for diagnosis and further clinical management. **Objective** To describe the cross-sectional imaging findings of patients with acquired tracheoesophageal fistula evaluated at a tertiary teaching hospital.**Methods** This retrospective imaging-based study was conducted in the Department of Radiodiagnosis at a tertiary teaching hospital in Agartala, Tripura between June and November. Patients with clinical suspicion of tracheoesophageal fistula who underwent contrast-enhanced computed tomography (CECT) of the thorax with oral contrast administration were included. CT images were evaluated for the presence and location of the fistulous tract, esophageal wall abnormalities, airway involvement, mediastinal changes, and pulmonary findings related to aspiration.**Results** Five patients with acquired tracheoesophageal fistula were identified during the study period. Three cases were secondary to squamous cell carcinoma of the esophagus and two were associated with corrosive ingestion. Direct visualization of the fistulous tract and contrast leakage into the tracheobronchial tree were key diagnostic findings. Associated pulmonary abnormalities included consolidation, ground-glass opacities, and tree-in-bud nodules consistent with aspiration pneumonitis. **Conclusion** Multidetector CT with oral contrast administration provides a comprehensive evaluation of acquired tracheoesophageal fistula by accurately delineating the fistulous tract, identifying the underlying etiology, and detecting pulmonary complications related to recurrent aspiration.

KEYWORDS : Computed tomography, esophageal carcinoma, erosive ingestion, thoracic imaging, tracheoesophageal fistula.

INTRODUCTION

Tracheoesophageal fistula (TEF) refers to an abnormal communication between the esophagus and the tracheobronchial tree resulting in direct passage of esophageal contents into the respiratory tract. While congenital TEF is commonly diagnosed during infancy, acquired forms occur later in life and are typically associated with a variety of pathological processes involving the esophagus or adjacent mediastinal structures. The presence of a fistulous tract leads to recurrent aspiration, chronic cough, respiratory infections, and progressive pulmonary complications if left untreated.

In adults, malignancy represents the most common cause of acquired tracheoesophageal fistula, particularly advanced esophageal carcinoma and bronchogenic carcinoma. Direct tumor invasion, radiotherapy-induced necrosis, and chemotherapy-related mucosal injury can weaken the esophageal wall and lead to erosion into the adjacent tracheobronchial tree [1–3]. The incidence of TEF in patients with advanced esophageal carcinoma has been reported to range between 5% and 15%, and its development often indicates locally advanced disease [4].

Corrosive ingestion represents another important cause of acquired TEF, especially in developing countries where accidental or intentional ingestion of caustic substances remains relatively common. Strong acidic or alkaline agents can cause severe chemical injury to the esophageal mucosa, resulting in ulceration, transmural necrosis, and subsequent fibrosis. Progressive tissue destruction may eventually lead to the formation of an abnormal communication with adjacent airway structures [5].

Clinically, patients with acquired TEF frequently present with persistent cough, recurrent pneumonia, dyspnoea, and dysphagia. A classical symptom described in the literature is Ono's sign, characterized by paroxysmal coughing immediately after swallowing liquids [6]. However, these symptoms are often nonspecific and may mimic other respiratory or gastrointestinal disorders, leading to delays in diagnosis. Historically, contrast esophagography was considered the primary imaging modality for detecting tracheoesophageal fistulas. However, with the advent of multidetector computed tomography (CT), cross-sectional imaging has become increasingly important in evaluating suspected cases. CT imaging provides a comprehensive assessment by demonstrating the fistulous tract, identifying the underlying pathology, and detecting associated pulmonary complications such as aspiration pneumonitis [7–9].

The present study describes the cross-sectional imaging findings of patients with acquired tracheoesophageal fistula evaluated at a tertiary teaching hospital in Agartala, Tripura, with particular emphasis on CT imaging features, anatomical localization of the fistulous tract, and associated pulmonary abnormalities.

MATERIALS AND METHODS

Study Design and Setting

This retrospective imaging-based study was conducted in the Department of Radiodiagnosis at a tertiary teaching hospital in Agartala, Tripura. The study period extended from June'25 to November'25.

Patient Data Collection

Clinical data including demographic details, presenting symptoms, and relevant clinical history were retrieved from hospital records. Particular attention was given to the presence of esophageal malignancy or history of corrosive ingestion.

CT Imaging Protocol

Contrast-enhanced computed tomography (CECT) of the thorax was performed on a 128-slice multidetector CT scanner. The scan range extended from the thoracic inlet to the upper abdomen.

Oral water-soluble iodinated contrast (diluted) was administered immediately prior to and during image acquisition to opacify the esophageal lumen and facilitate detection of abnormal communication with the airway.

Intravenous iodinated contrast (iopromide 300 mg I/mL) was administered at a dose of 1.2 mL/kg through a peripheral venous

catheter using a power injector at a rate of 3 mL/s, followed by a saline flush.

Image acquisition was performed in the venous phase.

Axial images were reconstructed at 1-mm slice thickness, and multiplanar reformations were generated in coronal and sagittal planes.

Image Analysis

CT images were evaluated for:

- Presence and location of fistulous communication
- Esophageal wall abnormalities
- Airway involvement
- Mediastinal inflammatory changes
- Pulmonary findings related to aspiration

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CASE DESCRIPTIONS

Case 1

A 38-year-old male with previously treated squamous cell carcinoma of the mid-esophagus presented with progressive dyspnoea, persistent cough, and low-grade fever for four weeks. Contrast-enhanced CT of the thorax demonstrated irregular circumferential thickening of the mid-thoracic esophagus (approximately T5–T6 vertebral level) with focal disruption of the posterior esophageal wall. A 4-mm fistulous tract extending from the esophagus to the trachea was identified. Oral contrast leakage into the tracheal lumen confirmed the presence of a tracheoesophageal fistula. Associated pulmonary findings included right lower-lobe consolidation and tree-in-bud nodularity, consistent with aspiration pneumonitis.

Case 2

A 61-year-old male presented with progressive dysphagia and recurrent respiratory infections. CT imaging demonstrated irregular circumferential thickening of the mid-thoracic esophagus (approximately T6–T7 level) with luminal narrowing. A fistulous communication between the esophagus and the right main bronchus was identified. Oral contrast administered prior to scanning was visualized entering the bronchial lumen. Patchy dependent consolidation in the right lower lobe suggested aspiration-related lung injury.

Case 3

A 55-year-old female with known squamous cell carcinoma of the esophagus presented with cough aggravated by swallowing liquids. CECT thorax demonstrated eccentric wall thickening involving the upper thoracic esophagus (approximately T3–T4 level). Multiplanar reconstructions revealed a small fistulous tract communicating with the trachea. Pulmonary findings included bilateral lower-lobe ground-glass opacities, consistent with recurrent aspiration.

Case 4

A 29-year-old female presented with dysphagia and chronic cough three months after ingestion of a corrosive substance. CT imaging demonstrated circumferential thickening and luminal narrowing of the cervical esophagus (approximately C7–T1 level), consistent with post-corrosive injury. A fistulous communication between the posterior esophageal wall and the trachea was identified. Bilateral lower-lobe consolidation suggested aspiration pneumonitis.

Case 5

A 33-year-old male with a history of corrosive ingestion presented with recurrent pneumonia. CT imaging demonstrated fibrotic narrowing of the upper thoracic esophagus (approximately T3–T4 level) with a fistulous tract communicating with the left main bronchus. Associated pulmonary findings included consolidation in the left lower lobe.

RESULTS

Five patients with acquired tracheoesophageal fistula were identified during the study period.

Three cases were associated with squamous cell carcinoma of the esophagus, while two cases occurred following corrosive ingestion.

The most common CT findings included:

- Direct visualization of the fistulous tract
- Leakage of oral contrast into the airway
- Esophageal wall thickening or fibrotic narrowing
- Pulmonary abnormalities consistent with aspiration

The mid-thoracic esophagus was the most common site of fistula formation in malignant cases, whereas corrosive-related fistulas were more frequently located in the cervical or upper thoracic esophagus. Pulmonary abnormalities were present in all patients.

Table 1 – Clinical and Radiological Findings

Case	Age/Sex	Etiology	Site of fistula	Esophageal findings	Pulmonary findings
1	38/M	SCC esophagus	Mid esophagus – trachea	Irregular thickening	Right lower lobe consolidation
2	61/M	SCC esophagus	Mid esophagus – RMB	Circumferential thickening	Patchy consolidation
3	55/F	SCC esophagus	Upper esophagus – trachea	Eccentric thickening	Ground glass opacity
4	29/F	Corrosive	Cervical esophagus – trachea	Circumferential thickening	Bilateral consolidation
5	33/M	Corrosive	Upper esophagus – LMB	Fibrotic narrowing	Left lower lobe consolidation

Representative images of the study

Figure 1. *Coronal CECT demonstrating iodine contrast jetting (arrow) from the esophageal lumen into the trachea.*

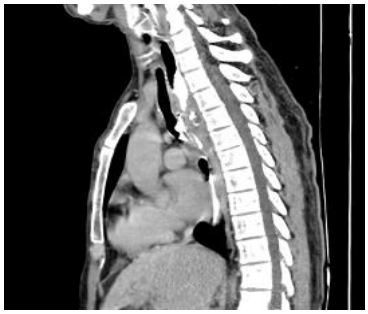

Figure 2. *Sagittal reconstruction delineating the 4 mm fistulous tract.*

Figure 3. *Axial CECT image at the level of the carina showing fistulous communication between the esophagus and the right main bronchus, with visible contrast pooling and adjacent inflammatory changes.*

Figure 4. *Coronal and axial CECT of the thorax showing parenchymal changes in the upper lobes consistent with aspiration pneumonitis, including areas of consolidation and peribronchial thickening. No contrast leak is visible in this section.*


Literature Comparison Tables for Acquired Tracheoesophageal Fistula

Table 2. Comparison of Selected Published Studies on Acquired Tracheoesophageal Fistula

Author	Year	Study Type	Number of Patients	Common Etiology	Key Findings
Reed et al.	2003	Review article	NA	Esophageal malignancy	TEF commonly occurs in advanced esophageal carcinoma and is associated with severe aspiration complications
Madan et al.	2013	Clinical review	NA	Malignancy, prolonged intubation	Emphasized the role of CT and endoscopy in diagnosing acquired TEF
Kim et al.	2020	Review article	NA	Malignancy	Multidetector CT and bronchoscopy are important diagnostic tools
Carter et al.	2014	Radiology review	NA	Esophageal carcinoma	CT useful for identifying fistula and associated mediastinal involvement
Sharma et al.	2022	Case series	6	Esophageal carcinoma	CT effectively demonstrated fistulous tract and pulmonary complications
Present Study	2025	Case series	5	SCC esophagus (3), corrosive injury (2)	CT with oral contrast accurately demonstrated fistulous communication and aspiration-related lung changes

The findings of the present series are broadly consistent with previously published reports, which identify esophageal malignancy as the most common cause of acquired tracheoesophageal fistula and highlight the important diagnostic role of cross-sectional imaging.

Table 3. CT Imaging Findings Reported in Acquired Tracheoesophageal Fistula

Imaging Finding	Description	Clinical Significance	Reported in Literature
Direct fistulous tract	Visible communication between esophagus and trachea or bronchus	Definitive diagnostic feature	Carter et al., Kim et al.
Oral contrast leakage into airway	Contrast seen entering trachea or bronchi	Confirms presence of fistula	Madan et al.
Esophageal wall thickening	Irregular or circumferential thickening	Suggests malignant etiology	Carter et al.
Esophageal luminal narrowing	Smooth or irregular narrowing	Seen in post-corrosive injury	Mungan et al.
Mediastinal inflammatory changes	Fat stranding or soft tissue changes	Indicates surrounding inflammation	Kim et al.
Pulmonary consolidation	Segmental or lobar consolidation	Aspiration pneumonitis	Reed et al.
Ground-glass opacities	Patchy ground-glass attenuation	Early aspiration changes	Carter et al.
Tree-in-bud nodules	Centrilobular nodules with branching pattern	Bronchiolar spread of infection	Kim et al.

The CT imaging findings observed in our patients correspond with characteristic features reported in the literature, including direct visualization of the fistulous tract, contrast leakage into the airway, and aspiration-related pulmonary changes

DISCUSSION

Acquired tracheoesophageal fistula (TEF) is an uncommon but clinically significant pathological entity characterized by abnormal communication between the esophagus and the tracheobronchial tree. Although congenital TEF is well described in the neonatal population, acquired forms occur predominantly in adults and are usually associated with malignancy, prolonged intubation, trauma, infection, or corrosive injury to the esophagus. Among these etiologies, esophageal carcinoma remains the most frequent cause, accounting for the majority of malignant TEFs reported in the literature [1, 2]. The development of TEF in patients with esophageal cancer often indicates locally advanced disease and is associated with significant morbidity due to recurrent aspiration and pulmonary infection.

The anatomical relationship between the esophagus and the trachea plays an important role in the pathogenesis of TEF. The posterior membranous wall of the trachea lies directly adjacent to the anterior wall of the esophagus, separated only by a thin layer of connective tissue without an intervening serosal barrier. As a result, destructive processes involving either structure can easily extend into the other. In malignant TEF, direct tumor invasion, radiation-induced tissue necrosis, and chemotherapy-related mucosal injury may collectively weaken the esophageal wall, eventually resulting in erosion into the tracheobronchial tree [3, 4].

Previous studies have reported that 5–15% of patients with advanced esophageal carcinoma may develop tracheoesophageal fistula, particularly in cases involving squamous cell carcinoma of the mid-thoracic esophagus [3]. This predilection is thought to be related to the close anatomical proximity of the esophagus to the trachea and main bronchi at this level. In the present series, all malignant cases involved squamous cell carcinoma of the esophagus, with fistulous communication occurring most commonly in the mid-thoracic esophagus, consistent with findings reported in earlier studies [4, 5].

Corrosive ingestion represents another important etiology of acquired TEF, particularly in developing regions where accidental or intentional ingestion of caustic substances remains relatively common. Strong alkaline or acidic agents can cause severe chemical injury to the esophageal mucosa. The pathological process typically begins with acute inflammation followed by ulceration and transmural necrosis. During the healing phase, fibrosis and strictures may develop. In severe cases, progressive tissue destruction may extend beyond the esophageal wall and result in fistulous communication with adjacent airway structures [5, 6]. In the present study, two patients developed TEF following corrosive ingestion, and both demonstrated esophageal narrowing with fibrotic wall thickening, findings characteristic of post-corrosive esophageal injury.

The clinical presentation of acquired TEF is often nonspecific and may lead to delayed diagnosis. Patients commonly present with persistent cough, recurrent pneumonia, dyspnea, dysphagia, and weight loss. One of the classic clinical manifestations described in the literature is

Ono's sign, characterized by paroxysmal coughing immediately after swallowing liquids. This symptom occurs due to direct passage of swallowed material into the airway through the fistulous tract [6]. However, because these symptoms overlap with other respiratory and gastrointestinal conditions, imaging plays a critical role in establishing the diagnosis.

Historically, contrast esophagography was considered the primary imaging modality for detecting tracheoesophageal fistulas. Water-soluble contrast agents are typically used to demonstrate contrast leakage from the esophagus into the airway. Although fluoroscopy remains useful for identifying fistulous communication, it has several limitations. Small fistulous tracts may be missed, and fluoroscopy provides limited information regarding surrounding mediastinal structures and associated pulmonary complications [7].

With the development of multidetector computed tomography, cross-sectional imaging has become the preferred modality for evaluating suspected cases of acquired TEF. CT imaging offers several advantages over conventional fluoroscopy. It allows direct visualization of the fistulous tract, evaluation of esophageal wall abnormalities, and assessment of adjacent mediastinal structures. In addition, CT provides valuable information regarding the underlying etiology, particularly in cases of malignancy or corrosive injury [8, 9]. Administration of oral contrast during CT imaging significantly improves diagnostic accuracy by demonstrating contrast leakage into the tracheobronchial tree. Multiplanar reconstruction techniques further enhance the ability to detect small fistulous tracts and determine their anatomical orientation. In the present study, multiplanar CT reconstructions in coronal and sagittal planes were particularly useful for delineating the fistulous communication and identifying its relationship with adjacent airway structures [8, 9].

Another important advantage of CT imaging is the ability to evaluate pulmonary complications associated with recurrent aspiration. Repeated passage of esophageal contents into the airway can lead to aspiration pneumonitis, bronchiectasis, and chronic lung infection. The most commonly reported CT findings include segmental or lobar consolidation, ground-glass opacities, and tree-in-bud nodularity, which represent bronchiolar inflammation and infection [9, 10]. In the present series, pulmonary abnormalities were observed in all patients and included consolidation, ground-glass opacities, and tree-in-bud nodules, findings consistent with aspiration-related lung injury.

The anatomical location of the fistula may vary depending on the underlying cause. Malignant fistulas most commonly involve the mid-thoracic esophagus and often communicate with the trachea or right main bronchus. In contrast, fistulas resulting from corrosive injury may occur at the cervical or upper thoracic esophagus, reflecting the pattern of mucosal injury following ingestion of caustic substances [5, 10]. These observations were also noted in the present study.

Although CT imaging plays a pivotal role in the diagnosis of TEF, correlation with endoscopic findings may be useful in selected cases. Bronchoscopy and esophagoscopy allow direct visualization of the fistulous opening and help assess the extent of mucosal involvement [11, 12]. Nevertheless, CT remains indispensable for evaluating the overall thoracic anatomy and identifying complications associated with the fistula.

The findings of the present study are consistent with previous reports emphasizing the value of cross-sectional imaging in the evaluation of acquired tracheoesophageal fistula. Multidetector CT with oral contrast administration provides a comprehensive diagnostic assessment by demonstrating the fistulous tract, identifying the underlying pathology, and detecting associated pulmonary abnormalities [9, 10].

CONCLUSION

Acquired tracheoesophageal fistula is an uncommon but clinically significant condition that most frequently occurs secondary to advanced esophageal malignancy or corrosive injury in adults. The condition is associated with substantial morbidity due to recurrent aspiration and respiratory infections, and early diagnosis is essential for timely clinical management.

Multidetector computed tomography with oral contrast administration plays a crucial role in the evaluation of suspected tracheoesophageal fistula. CT imaging allows direct visualization of the fistulous communication, identification of underlying esophageal pathology, and assessment of associated mediastinal and pulmonary complications in a single examination. Multiplanar reconstructions further enhance the detection and anatomical characterization of the fistulous tract.

In the present series, CT imaging reliably demonstrated the fistulous communication in all patients and also identified aspiration-related pulmonary abnormalities including consolidation, ground-glass opacities, and tree-in-bud nodularity. These findings highlight the value of cross-sectional imaging in the comprehensive assessment of acquired tracheoesophageal fistula.

Recognition of these characteristic imaging features is essential for radiologists, particularly when evaluating patients with esophageal malignancy or a history of corrosive ingestion presenting with respiratory symptoms, as early radiological diagnosis can facilitate prompt multidisciplinary management and potentially reduce complications associated with recurrent aspiration.

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