THORACIC COMPLICATIONS OF OESOPHAGEAL CARCINOMA- A RETROSPECTIVE ANALYSIS OF CT APPEARANCES

Piyush Joshi[1]

[1]*Associate Professor, Department of Radiology, INHS, Asvini, Colaba, Mumbai.*

ABSTRACT

BACKGROUND

Oesophageal cancer is a common gastrointestinal tract malignancy and Computed Tomography (CT) is generally used for its initial evaluation and staging. Due to the anatomical relationships of the oesophagus, malignancies afflicting it can also give rise to various pulmonary and thoracic complications. The staging CT can also be used to detect and evaluate these complications. Detection of concurrent thoracic complications in addition to the primary malignancy is imperative to institute appropriate management.

The aim of the study is to analyse and discuss the various thoracic complications in cases of oesophageal carcinoma detected on Multidetector Computed Tomography (MDCT).

MATERIALS AND METHODS

MDCT images of 27 cases of histopathologically-proven carcinoma oesophagus who had thoracic complications in addition to features of malignancy and metastases were retrospectively analysed. The various pulmonary and thoracic complications in addition to the primary lesions were assessed and evaluated.

RESULTS

There were 27 cases of oesophageal carcinoma with complications, of which there were 20 patients who had pulmonary consolidation/pneumonitis, 5 had oesophago-respiratory fistulae, 1 had a lung abscess, 2 had pericardial effusions, 3 had pleural effusions, 2 cases of airway compromise with atelectasis and 2 cases with Pulmonary Thromboembolism (PTE).

CONCLUSION

The routine chest CT for evaluation and staging of the primary tumour in cases of oesophageal carcinoma can also reveal thoracic complications directly or indirectly related the cancer some of which may alter management. The most common of these are pneumonia and oesophago-respiratory fistulas. Others like pulmonary thromboembolism may require immediate intervention. An awareness of the spectrum of imaging appearances of these complications and due vigilance while interpreting chest CT studies will aid decision making and institution of appropriate management.

KEYWORDS

Oesophageal Carcinoma, Computed Tomography, Aspiration Pneumonia, Oesophageal Fistula, Malignant Pleural Effusion, Malignant Pericardial Effusion, Pulmonary Thromboembolism.

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BACKGROUND

Oesophageal cancer is one of the more common malignancies of the gastrointestinal tract. This cancer may show involvement of contiguous structures or metastases to distant organs. Computed Tomography (CT) has been used for the past four decades for evaluation of this malignancy and has emerged as one of the most important modalities.[1] This is because CT allows concurrent evaluation of the primary lesion, local spread, nodal involvement as well as pulmonary and hepatic metastases in the same study. The initial protocols and evaluation criteria were pioneered more than four decades ago and have been continuously refined thereafter.[2] Multidetector CT (MDCT) has emerged as the principal imaging investigation prior to the institution of treatment- definitive or palliative for assessment of the primary lesion.[3] In addition, it is the mainstay of the staging evaluation. It has also been used for the post-treatment evaluation of these malignancies.[4] In recent years, there has also been an interest in pulmonary and thoracic complications of oesophageal disorders. Anatomically, the upper third of the oesophagus is closely related to the trachea, whereas the lower third is in relation with the pleura on the right side at places. Therefore, processes involving the oesophagus are likely to have a direct bearing on the trachea and pleura. Furthermore, patients of carcinoma oesophagus are likely to have dysphagia and some of them may have aspiration, a condition, which is likely to further compound these malignancies. Cachexia may also result in loss of body and mediastinal fat, which could reduce fascial

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Corresponding Author:
Dr. Piyush Joshi,
Associate Professor, Department of Radiology,
INHS, Asvini, Colaba, Mumbai-400005.
E-mail: piyushjoshi@hotmail.com
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boundaries, which act as a barrier to local spread of malignancy and could lead to development of fistulae. There has also been a renewal of interest in pulmonary complications in oncological patients in general as a result of hypercoagulable states or due to prolonged immobilisation, which could lead to deep venous thrombosis. Therefore, MDCT is useful not only to evaluate the local extent and distant metastases, but also to evaluate pulmonary complications, which may have a direct bearing on the treatment or may require alternative management to be instituted. As all patients of oesophageal carcinoma undergo a staging CT, it is imperative that radiologists be aware of the imaging appearances of these complications as well and carry out a vigilant examination, so that concurrent treatment of these complications could be carried out leading to a favourable patient outcome.

Aims and Objectives

To retrospectively analyse and discuss, the various thoracic complications detected on staging Multidetector Computed Tomography (MDCT) carried out for known cases of oesophageal carcinoma.

MATERIALS AND METHODS

The MDCT images of 27 cases of histopathologically-proven carcinoma oesophagus who had thoracic complications in addition to features of malignancy and metastases over a two-year period were included in the study and were retrospectively analysed. Patients with other comorbid conditions or confounding pulmonary findings were excluded from this retrospective study. Pre- and post-intravenous contrast images were studied, which had been obtained in spiral mode with a section collimation of 0.75 mm and were analysed in both 5 mm and 2 mm slices. The oesophageal lumen had been distended by asking the patient to swallow dilute iodinated contrast immediately prior to both the pre and post-intravenous contrast scans. The various pulmonary and thoracic complications in addition to the primary lesions (i.e., tumour extent, lymph node involvement and metastatic lesions) were assessed. These complications were then analysed and tabulated.

Observations and Results

Of the 27 cases of oesophageal carcinoma with thoracic complications, there were 20 patients who had pulmonary consolidation/pneumonitis, 5 had oesophago-respiratory fistulae, 1 had a lung abscess, 2 had pericardial effusions, 3 had pleural effusions, 2 patients had airway compromise with atelectasis and 2 patients had features of Pulmonary Thromboembolism (PTE). We did not encounter any cases of oesophageal carcinoma with oesophago-pleural fistula. Some patients had more than one complication. These findings are summarised in Table 1.

It is clear from the above that the largest number of complications result from aspiration and/or a superadded infective process (consolidation/pneumonia), which account from 74% of the total complications. In some cases, an abscess might also result. Thus, relieving the distal obstruction in oesophageal malignancy in these cases whether by an oesophageal stenting procedure or by a feeding gastrostomy might be required as an adjunct to management in these cases.

Some complications could be due to direct extension of the malignancy or external compression by the malignant lymph node mass. Our study included 5 cases (18.5%) of oesophago-respiratory fistulae (4 cases of acquired trachea-oesophageal fistula and one case of oesophago-pulmonary fistula). The case of oesophago-pulmonary fistula showed oral contrast delineating the fistulous communication and extending into the lung. In addition, there were 2 cases (7.4%) of atelectasis due to compression of bronchi. The first group could present with non-resolving pneumonia.

We had 3 cases (11%) of pleural effusion and 2 cases (7.4%) of pericardial effusion. All effusions were clear with an attenuation less than 20 HU. Recognition of these was important due to the possibility of respiratory compromise or cardiac tamponade.

We also encountered 2 cases (7.4%) of Pulmonary Thromboembolism (PTE), and in both these cases, urgent treatment had been instituted.

Therefore, in our study, the most common complication was pneumonia, which was commonly due to aspiration (Figure 1) or rarely due to a fistulous communication. Very occasionally, a lung abscess resulted as a further complication (Figure 2). Oesophago-respiratory fistulae though less common were encountered occasionally (Figure 3). Pericardial effusions (Figure 4) and pleural effusions (Figure 5) were the other common complications visualised. Incidentally, we also picked up a few cases of pulmonary thromboembolism. All these conditions warranted either alteration of the management or institution of urgent management.

Complication	Patients (n=27)
Consolidation/pneumonitis	20 (74%)
Lung abscess	1 (3.7%)
Airway compromise with atelectasis	2 (7.4%)
Oesophago-respiratory fistula	5 (18.5%)
Pleural effusion	3 (11%)
Pericardial effusion	2 (7.4%)
Pulmonary thromboembolism	2 (7.4%)

Table 1. Thoracic Complications in Cases of Oesophageal Carcinoma

Figure 1. Contrast-Enhanced CT Chest Showing Circumferential Oesophageal Thickening in a Case of Carcinoma Oesophagus with Subsegmental Consolidation in the Right Lung

Figure 2. Contrast-Enhanced CT Chest Showing Circumferential Oesophageal Thickening in a Case of Carcinoma Oesophagus with an Abscess Cavity with Aspirated Oral Contrast Material within and Areas of Consolidation in the Right Lung

Figure 3. Contrast-Enhanced CT Chest Showing Circumferential Proximal Oesophageal Thickening in a Case of Carcinoma Oesophagus with a Hypodense Track Extending to the Right Main Bronchus - Oesophago-Bronchial Fistula

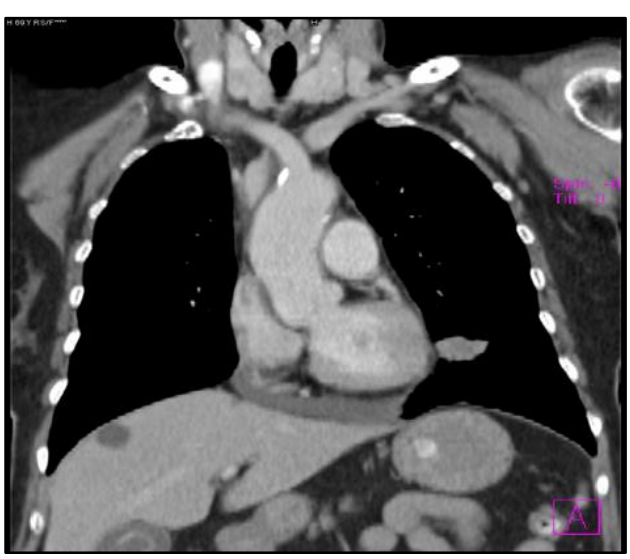

Figure 4. Contrast-Enhanced CT Chest Coronal Reformat Showing in a Case of Carcinoma Oesophagus Showing Pericardial Effusion

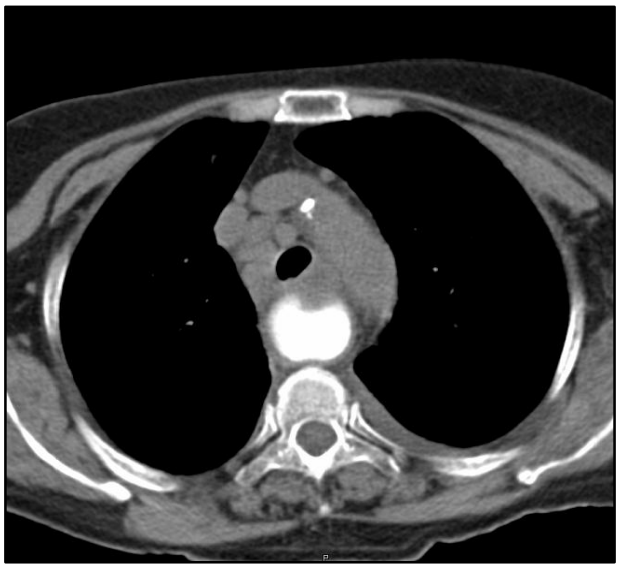

Figure 5. Unenhanced CT Chest Showing Eccentric Oesophageal Thickening in a Case of Carcinoma Oesophagus with Pretracheal Lymph Nodes and a Left-Sided Pleural Effusion

DISCUSSION

CT has become the most important modality for the comprehensive workup of cases of oesophageal carcinoma. CT is used for the local extent and evaluation of mediastinal invasion. This includes assessment of perioesophageal fat, aortic involvement and tracheal and bronchial involvement. In addition, it is also useful to assess locoregional and distant lymph nodes as also distant metastases. Multidetector CT has added to the efficacy and volume rendering techniques including virtual bronchoscopy are further aiding diagnosis.[1] Most workers find CT to be a very useful tool not just to assess the local extent and staging, but also to assess its resectability.[2] Multiphasic evaluation is a further refinement of the technique, which allows better evaluation of the primary lesion.[3] Therefore, while multimodality assessment is increasingly being resorted to in carcinoma oesophagus, the initial evaluation is nearly always carried out with MDCT.[4]

Carcinomas of the oesophagus are staged according to the TNM classification devised by the American Joint Committee on Cancer (AJCC). The T classification is on the basis of the local extent of the primary cancer. The T1 tumours involve the lamina propria, muscularis mucosae or submucosa, whereas the T2 tumours involve the muscularis propria. CT is not a reliable technique to distinguish these stages from one another and the may present as eccentric subtle wall thickening or in intraluminal mass. The T3 tumours are more easily detected as a definite mass or wall thickening with proximal obstruction. There may also be haziness of the surrounding fat with the plane with adjacent structures being preserved. The T4 tumours are those which involve adjacent structures. T4a tumours involve the pleura, pericardium or diaphragm and maybe resectable. These maybe suspected if there is loss of fat planes, pericardial or pleural thickening/effusion or indentation of the heart by the mass. On the other hand, involvement of aorta and other major vessels, trachea or main-stem bronchi and vertebrae is designated as T4b and is considered unresectable. Aortic

involvement is suspected if the arc of contact with the tumour is more than 90°. Tracheobronchial involvement is suggested by indentation or presence of a fistula.

The lymph node (N) classification is on the basis of the number of lymph nodes in the para-oesophageal stations that are involved - N0 (no involved nodes), N1 (one to three nodes involved), N2 (three to six nodes involved) or N3 (seven or more nodes involved). Lymph nodes are considered involved on the basis of size criteria (intrathoracic nodes more than 10 mm in short axis and supraclavicular nodes more than 5 mm in short axis), loss of the fatty hilum and loss of smooth border and homogenous attenuation.

The involvement of distant organs is called the M classification where M0 tumours do not have any metastatic lesions and M1 tumours show presence of distant metastases. Common metastases are to the liver, lungs, bones, adrenals and occasionally to the brain.

Histopathologically, these tumours are classified as squamous cell carcinoma or adenocarcinoma. Squamous cell carcinoma is more common in the upper and middle third of the oesophagus and maybe associated with alcohol consumption, cigarette smoking, genetic conditions like Plummer-Vinson syndrome and environmental factors like radiation exposure. Adenocarcinoma is more common in the lower third and maybe associated with Barrett syndrome, which is columnar metaplasia secondary to gastroesophageal reflux disease.[5]

However, in addition to the primary tumour and staging, CT also detects various pulmonary and thoracic complications, which are a direct consequence of oesophageal carcinoma. Some of these complications may contribute to mortality and morbidity independent of the malignancy. It is therefore important to be aware of these complications and their radiological appearances.

The most common of these complications is pneumonitis, which could be due to aspiration or as a consequence of airway compromise. It could also be due to an oesophago-respiratory fistula. Aspiration pneumonia is most commonly seen on imaging as a bronchopneumonia with scattered airspace opacities. There could also be scattered nodular opacities and increased attenuation with a tree in bud configuration. It is unusual to find a lobar airspace consolidation. The anatomical distribution depends on the patient's body position. The posterior segments of the upper lobes and the superior segments of the lower lobes are most commonly affected in patients who are supine while the lower lobe posterior segments are more likely to be affected in patients who walk erect.[6]

Large proximal oesophageal cancers may also compress or involve the proximal airways causing respiratory compromise and resultant post-obstructive atelectasis.[7]

Occasionally, infection can result in a lung abscess, which is typically thick walled and may or may not communicate with the bronchial tree.[6]

Oesophago-respiratory fistulas may occur in 5-10% of patients with late stage oesophageal carcinoma and it is mainly a diagnosis of exclusion with a strong index of suspicion to be maintained in any patient with a known oesophageal neoplasm in a patient in whom there is recurrent pneumonia. The area of pulmonary consolidation is generally unilateral, but may occasionally be bilateral. CT can be occasionally helpful in the demonstration of a fistulous tract, which may definitively clinch the diagnosis.[6] Most commonly, the fistula is seen to involve the trachea, but occasionally the main bronchi are involved more on the left side. On rare occasions, the fistulous tract can directly erode in the lung parenchyma.[8] Nowadays, CT virtual bronchoscopy is also being used as an adjunct to aid in the diagnosis of the precise site of these fistulae.[9]

Most of these patients present with a non-resolving pneumonia. In some cases, the iodinated oral contrast can be seen to track through to the involved segment and the track can be identified indirectly. In many cases, though the track may not be identified, even though the diagnosis may be suggested on CT. These patients would require further evaluation with bronchoscopy. The treatment of these fistulae could involve surgical bypass of the oesophagus along with or without stenting of the involved segment of the trachea. CT could also be useful in the post-treatment evaluation of these patients particularly to look for stent migration, stent fracture or other complications.

Pleural effusions are common in malignancy patients including carcinoma oesophagus. These effusions could be malignant or benign and sometimes large pleural effusions could cause compression and passive atelectasis of the underlying lung, which could result in respiratory compromise.

The aetiology of a benign pleural effusion could be impaired pleural fluid resorption. It could also be due to sympathetic fluid accumulation. In contrast, malignant pleural effusions are generally because of direct involvement of the pleura due to metastases.

Most malignant effusions have a clear appearance (attenuation of less than 20 HU) on CT and the absence of pleural thickening. Some malignant effusions may show nodular pleural thickening, which might be a pointer to malignancy. In most cases, however, it is not possible on CT alone to differentiate malignant from benign effusion.[7]

Malignant pleural effusions can be aspirated to provide immediate relief, but would require repeated aspiration as there would be a tendency to recur. Other treatment options could be drainage by an indwelling catheter or pleuroperitoneal shunting. Another option would be pleurodesis, which is contraindicated, however, in cases where there is trapped lung or multiple loculations or septations.

Another complication that can sometimes be associated with oesophageal carcinoma is the development of an oesophago-pleural fistula. This can be indicated by either the presence of pleural air or hydropneumothorax. In this too, CT is considered the imaging modality of choice. It is sometimes also possible to demonstrate the site of communication between the pleural space and the oesophagus on CT.[6]

In patients with oesophageal carcinoma, both benign and malignant pericardial effusions maybe seen. If large,

these can cause haemodynamic compromise and subsequent cardiac tamponade. If pericardial thickening is present, it may cause constrictive pericarditis.

Benign pericardial effusions like pleural effusions are likely to be due to impaired lymphatic drainage, more so in patients with of mediastinal lymph node involvement. Malignant pericardial effusions on the other hand are likely to be due to direct pericardial extension of the tumour.

The CT imaging characteristics of pericardial effusions are on the same line as pleural effusions. Benign pericardial effusions are likely to be clear with an attenuation value less than 20 HU. Most malignant effusions are also likely to be clear and indistinguishable from benign effusions, but in some cases may show nodularity or maybe of increased attenuation due to haemorrhage.[7]

Regardless of whether the effusions are in themselves benign or malignant, they can cause cardiac tamponade, if they increase rapidly. Therefore, their presence has to be communicated to the treating physician and adequate treatment instituted.

Patients with carcinoma oesophagus like all malignancies sometimes have a hypercoagulable state, which can lead to deep venous thrombosis and also Pulmonary Thromboembolism (PTE). This pulmonary thromboembolism can sometimes be detected on a routine staging CT. Even though, the protocol for a staging CT is not optimised for the same, a vigilant study of the staging CT can be useful in the detection of incidental and unsuspected PTE in the larger pulmonary arteries. Use of wide window settings (width 600, level 100-150 HU) even in the routine chest CT is especially useful in this regard.[7] Once PTE has been recognised, there should also be a search for Deep Venous Thrombosis (DVT). Recognition of PTE is important as failure to institute appropriate treatment can be life-threatening and could increase morbidity as well as mortality in these cases.

CONCLUSION

Patients of oesophageal carcinoma undergo a routine chest CT for evaluation and staging of the primary tumour. The routine chest CT can also reveal thoracic complications directly or indirectly related the cancer some of which may alter management. The most common complications are pneumonia and oesophago-respiratory fistulas, awareness of which is required for an early diagnosis. Additionally, sometimes complications with potentially high mortality and morbidity like pulmonary thromboembolism are present, which require urgent intervention. Radiologists need to be aware of the spectrum of imaging appearances of these complications and remain vigilant while interpreting chest CT studies of these patients.

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