

# Lymphoscintigraphy combined with single-photon emission computed tomography-computed tomography (SPECT-CT): A very effective imaging approach for identification of the site of leak in postoperative chylothorax

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## ABSTRACT

Post operative chylothorax is a known complication of various thoracic surgeries. It needs identification of precise site of leak in the thoracic duct. Lymphoscintigraphy can identify chyle leak but cannot delineate exact site of leak. SPECT-CT is precise in anatomic localisation and hence SPECT-CT should be combined with every lymphoscintigraphy in evaluation of clinically suspected case of post operative chylothorax. We report such a case.

**Keywords:** Chylothorax, esophagectomy, lymphoscintigraphy, SPECT-CT

## INTRODUCTION

Chylothorax means chyle containing lymphatic fluid accumulation within the pleural cavity. It is an uncommon but well-established complication of thoracic surgeries. Per operative injury to the thoracic duct gives rise to chylothorax, which is difficult to diagnose by a conventional imaging modality like computed tomography (CT) scan.

Lymphoscintigraphy, which is used to visualize lymphatic system after radiotracer injection can characterize the accumulated fluid as chyle and this can be combined with single-photon emission computed tomography-CT (SPECT-CT) for precise localization of the anatomical defect in the lymphatic system in chylothorax.

## CASE REPORT

A 60-year-old lady from Bhutan was diagnosed with squamous cell carcinoma of lower 1/3<sup>rd</sup> of esophagus. She was initially

treated with palliative radiotherapy in view of her poor general condition but showed excellent response in terms of reduction of tumor size and improvement of the general condition. Treatment strategy was changed, and a transthoracic esophagectomy was performed. The thoracic duct was ligated just above the hiatus.

Postoperative persistent pleural effusion of moderate severity (around 700 ml/day) along with hypoalbuminemia and hypokalemia raised the suspicion of chyle leak. Whole body lymphoscintigraphy was performed with <sup>99m</sup>Tc sulfur colloid filtered by 0.22 micron filter. 1.2 mCi (44 MBq) of the abovementioned radiotracer was subcutaneously injected in web spaces of each foot in divided doses. Immediately after the injection, whole body imaging was performed in a continuous acquisition mode starting from the feet. The regional SPECT-CT of the thorax was performed with a low energy high-resolution collimator (64 views and 30 s/view).

The whole body lymphoscintigram showed fairly prompt ascent of radio colloid up both lower limbs, and there was markedly increased accumulation of radiotracer in the right hemithorax over the right paramediastinal region [Figure 1].

Coronal SPECT image delineated the margin of the localized collection of radiotracer in a more elaborate manner. The medial most point of radiotracer uptake zone as observed in the coronal SPECT image was localized. After correlation with

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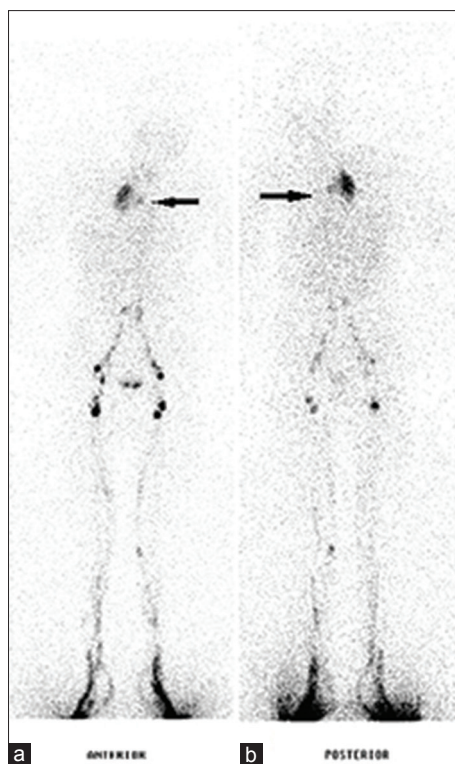


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**Figure 1:** Lymphoscintigram with  $^{99m}\text{Tc}$  sulfur colloid anterior (a) and posterior (b) view show the ascent of radiotracer of both lower limbs. There was markedly increased accumulation of radiotracer in the right hemithorax over the right paramediastinal region indicating chyle leak (arrow)

corresponding coronal CT section, this point was found to be situated just anterior to the D3–D4 vertebral margin [Figure 2]. The structural correlate provided by the CT component of the SPECT-CT helped the anatomical localization of the site of the leak that incidentally was found to be correct per operatively. This information obtained from SPECT-CT was of incremental value in comparison with planer lymphoscintigraphy.

Patient underwent right posterolateral thoracotomy and perforation was observed in the thoracic duct proximal to the level of the azygos arch causing chyle leak. Ligation of proximal thoracic duct was performed. Postoperatively pleural effusion gradually resolved and did not reappear even after resuming normal fat containing diet [Figure 3].

## DISCUSSION

Postoperative injury of the thoracic duct is the most common cause of chylothorax, usually after esophagectomy. The incidence of chylothorax following esophagectomy varies between 0.5% and 3.8%.<sup>[1,2]</sup> Incidence is higher in trans-hiatal approach than in trans-thoracic procedure.<sup>[3]</sup> Nontraumatic chylothorax is observed in lymphoma, filaria, chylous ascites, tuberculosis, sarcoidosis and mediastinal diseases like retrosternal goiter etc.

Diagnostic workup includes cholesterol and triglyceride measurement in pleural fluid. CT scan, lymphangiography and

lymphoscintigraphy are imaging modalities commonly used in the diagnosis of chylothorax. CT scan cannot differentiate between chylothorax from another cause of pleural effusion. Earlier, in lymphangiography oil soluble contrast media was being injected within the lymphatic system after selective cannulation of the thoracic duct (or cisterna chyli). It is no longer being practised because of complex cumbersome technical procedure and particle induced postprocedural obstruction of the smaller lymphatic channels. SPECT-CT gives combined anatomical and functional information.

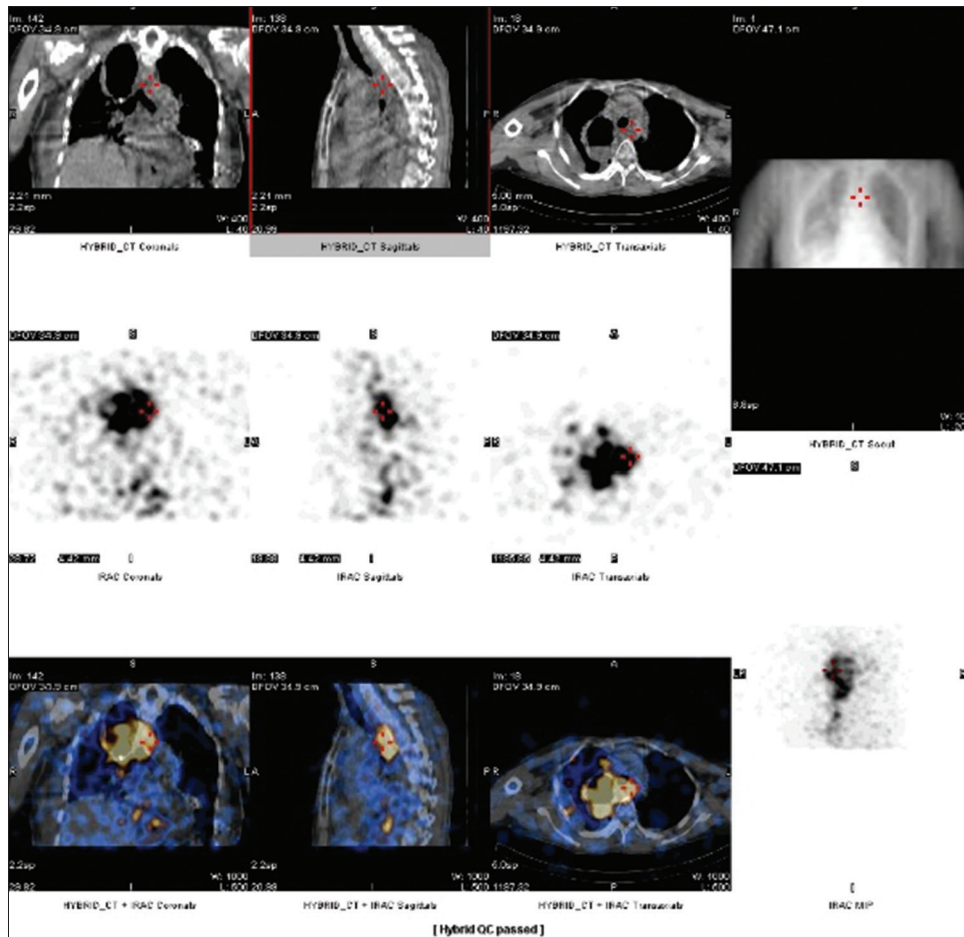
Lymphoscintigraphy which is used to visualize lymphatic system after radiotracer injection can be combined with SPECT-CT. Lymphoscintigraphy using  $^{99m}\text{Tc}$  – human serum albumin along with SPECT-CT was found useful to delineate the site and extent of lymphatic leaks.<sup>[4]</sup> In literature lymphoscintigraphy with SPECT-CT has been recommended for determination of the site of chyle leak after esophagectomy.<sup>[5,6]</sup> The role of dynamic imaging during lymphoscintigraphy has also been described in this context.<sup>[7]</sup>

Knowledge of anatomy of the thoracic duct including the anatomical variations is essential for image interpretation. Originating at cistern chyli, thoracic duct ascends behind aorta and enters thorax through aortic hiatus. In the right side of the posterior mediastinum, it ascends posterior to the esophagus and pericardium separated by a recess of right pleural cavity. At the level of D5 or D6, thoracic duct crosses to the left side and enters the superior mediastinum behind the aortic arch. After its exit through the superior thoracic aperture and entering to the neck it courses anterior to the scalenus muscle. Above the medial end of left clavicle, thoracic duct arches anteriorly and joins the blood circulation at the junction of the left internal jugular and left subclavian vein. Duplication, triplication and multiple collateral channels are common anatomical variants of the thoracic duct. Presence of rich collaterals of the thoracic duct helps in safe ligation of the duct after injury.<sup>[8]</sup>

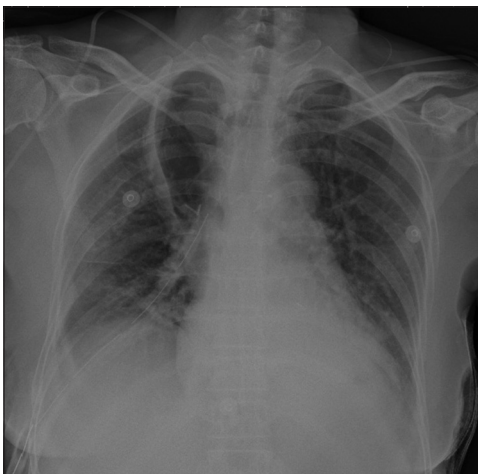
Postoperative chylothorax is initially treated conservatively by either medium chain oral triglyceride or total parenteral nutrition. The principle of conservative treatment is to minimize the lymph flow through the damaged thoracic duct. Surgical repair is indicated for the cases that fail to respond to conservative management. Idea about the precise location of the leak is essential before re-exploration for thoracic duct repair.

In the present case, thoracic duct was ligated during esophagectomy. Postligation chyle leak at the level proximal to the azygos vein could be explained by the formation of collateral lymphatic channels. The site of the leak was correctly identified by SPECT-CT and was successfully ligated after re-exploration.

In the case described above, postesophagectomy thoracic duct injury and chyle leak in a case of carcinoma esophagus were investigated. Although the leak was confirmed by



**Figure 2:** Single-photon emission computed tomography-computed tomography axial, coronal and sagittal images confirm the chyle leak from the thoracic duct. Point of leak (cursor) is seen as the medial most margins in coronal section that corresponds with D3–D4 vertebra. During operation, multiple small perforations of the thoracic duct were identified above the level of the azygos vein and clipped



**Figure 3:** X-ray chest on 5<sup>th</sup> postoperative day after right posterolateral thoracotomy and ligation of proximal thoracic duct shows no evidence of pleural effusion with expanded both lung fields

lymphoscintigraphy, SPECT-CT was found to be useful in identifying the site of chyle leak that helped in surgical management. Hence, lymphoscintigraphy should be combined with SPECT-CT for evaluation of all suspected cases of postoperative chylothorax.

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