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Transcervical mediastinoscopy in patients with a permanent tracheostomy: is it feasible?

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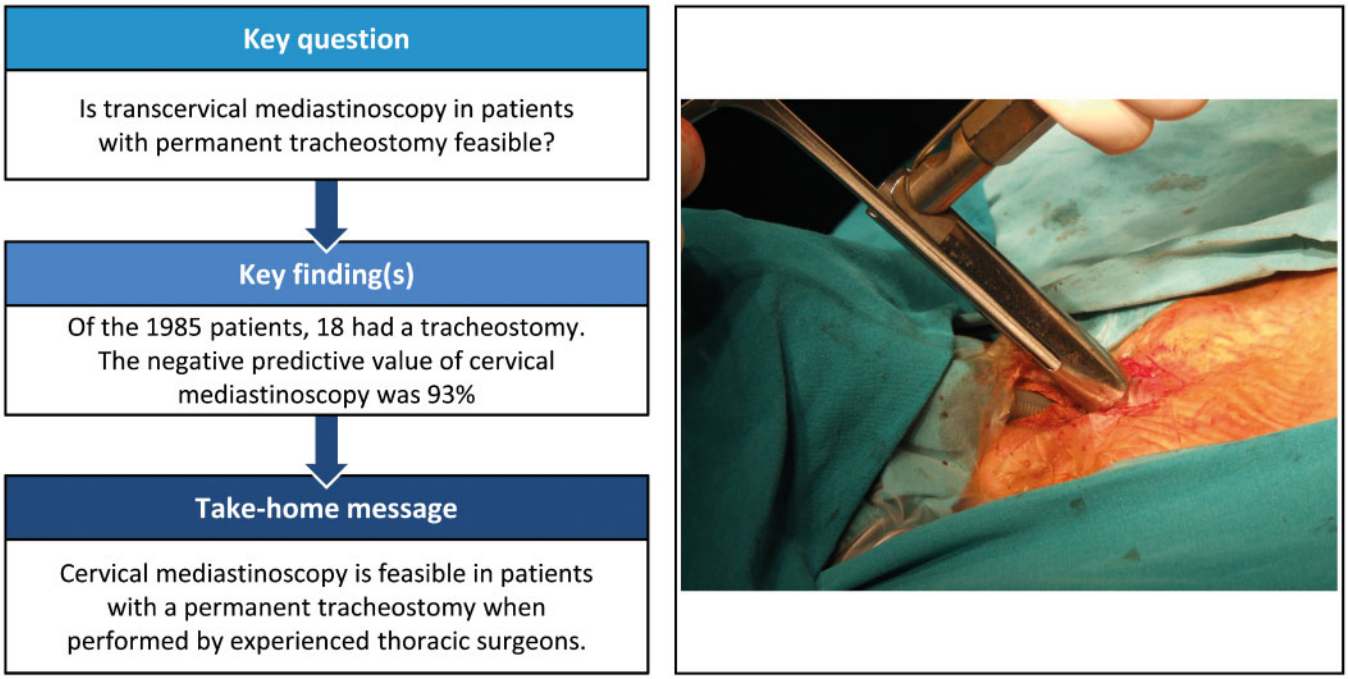

Abstract

OBJECTIVES: Cervical mediastinoscopy may become essential in patients with pathological lymph nodes at mediastinum after laryngectomy. However, having had a previous tracheostomy has been reported to be a contraindication for cervical mediastinoscopy.

METHODS: Between January 2010 and December 2017, cervical mediastinoscopy was performed for lung cancer staging in 1985 patients at the Department of Thoracic Surgery, Yedikule Chest Diseases and Thoracic Surgery Education and Research Hospital, Istanbul, Turkey. Eighteen of these patients (1%) had a permanent tracheostomy after total laryngectomy and cervical radiotherapy due to laryngeal carcinoma.

RESULTS: Cervical mediastinoscopy was performed in 18 patients with a permanent tracheostomy after total laryngectomy. The negative predictive value of cervical mediastinoscopy was 13/14 (93%). The average operative time was 63 min (SD 12.0, range 50–90 min). The negative predictive value of endobronchial ultrasonography was 4/7 (57%). Positron emission tomography–computed tomography had a positive predictive value of 3/15 (20%) and a negative predictive value of 2/3 (67%).

CONCLUSIONS: Contrary to the claims of 2 textbooks, cervical mediastinoscopy is a viable method for patients with a tracheostomy after laryngectomy. The negative predictive values of standard cervical mediastinoscopy and mediastinoscopy for patients with a tracheostomy after total laryngectomy are approximately equivalent. Our results indicate that cervical mediastinoscopy is a feasible method in patients with a permanent tracheostomy when applied by experienced thoracic surgeons in specialized hospitals.

Keywords: Cervical mediastinoscopy • Laryngeal carcinoma • Tracheostomy • Radiotherapy

INTRODUCTION

The annual risk for second primary tumours following laryngeal carcinoma is 1–7%, which persists for at least 10 years [1]. Pathological mediastinal lymph nodes may develop due to secondary primary tumours in the lungs or relapse of the laryngeal carcinoma.

Mediastinal lymph node staging in lung cancer treatment is the most important factor both for determining the appropriate treatment and for predicting prognosis [2]. Both computed tomography (CT) and positron emission tomography-CT (PET-CT) have relatively low sensitivity and specificity for evaluating mediastinal lymph nodes (74% and 69%; 74% and 84%, respectively) [3]. Invasive techniques are necessary for accurate mediastinal staging. Despite the development of endobronchial ultrasonography (EBUS) and transbronchial needle aspiration methods, standard transcervical mediastinoscopy is currently the gold standard for mediastinal lymph node sampling [4]. The efficacy and safety of cervical mediastinoscopy after total laryngectomy and cervical radiotherapy have not been documented [5].

Cervical mediastinoscopy may become essential in cases with pathological lymph nodes at mediastinum after laryngectomy. However, a previous tracheostomy has been reported to be a contraindication for cervical mediastinoscopy [4, 6].

Here, we established that cervical mediastinoscopy is a feasible treatment method for patients with laryngectomy based on 18 patients with permanent tracheostomy who underwent cervical mediastinoscopy for mediastinal staging.

MATERIALS AND METHODS

Patients

Between January 2010 and December 2017, cervical mediastinoscopy was performed for lung cancer staging in 1985 patients at Yedikule Chest Disease and Thoracic Surgery Hospital, Istanbul, Turkey. Eighteen of these patients (1%) had permanent tracheostomy after total laryngectomy and cervical radiotherapy due to laryngeal carcinoma. Cervical mediastinoscopy was performed for mediastinal staging in these 18 patients.

A limited number of patients, its retrospective approach and the failure to reach EBUS positive patients who have had a permanent tracheostomy are the limitations of our study.

Before surgery, all patients underwent clinical examination, preoperative routine blood examination, spirometry and cardiological consultation. Radiological monitoring was performed using chest X-ray, thoracic CT, PET-CT and cranial magnetic resonance imaging. Before mediastinoscopy, patients were referred to their otolaryngologists to exclude the possibility of laryngeal carcinoma recurrence. Patients with loco-regional disease were excluded from the study. Cervical mediastinoscopy for staging was performed in patients with tumours of smallest diameter >1 cm according to CT, mediastinal lymph nodes with a pathological standardized uptake value (SUV max) detected via PET-CT, central lung tumours that could only be resected by pneumonectomy and bilateral synchronous lung tumours.

Spirometry technique

A tracheostomy cannula that matched the permanent tracheostomy stoma was put in place and its cuff was inflated. The spirometry connection was linked with the appropriate apparatus in the spirometry room. The connection was tested by a spirometry technician.

Surgical technique

The patients were placed under general anaesthesia in the supine position (Fig. 1). Intubation was performed with a spiral tube through the permanent tracheostomy (Fig. 2). The surgical area and spiral tube were sterilized with 10% polyvinylpyrrolidone–iodine. The space between the tracheostomy cannula and stoma was filled with gauze patches (Fig. 3). The patient was covered with surgical drapes, and the sterile spiral intubation tube was linked to the respirator for ventilation. Mediastinoscopy incision was localized 5–10 mm below the tracheostomy stoma. Cervical mediastinoscopy for this subgroup of patients was different from the usual mediastinoscopy, and it required a unique approach. While surgeons can easily access the pretracheal fascia in standard mediastinoscopy, it cannot be performed routinely in patients with a tracheostomy who have received radiotherapy. When we could not find the pretracheal fascia, we proceeded through the lateral side of the trachea below the innominate artery by blunt and sharp dissection. After passing through the innominate artery, pretracheal fascia was opened. Our clinic's standard mediastinoscopy procedure is sampling right upper paratracheal lymph nodes (2R), right lower paratracheal lymph

Figure 1: Preoperative image of a tracheostomy.

Figure 2: Intubation with a spiral tube through the permanent tracheostomy.

Figure 3: The spiral tube was sterilized with 10% polyvinylpyrrolidone–iodine and the stoma filled with gauze patches.

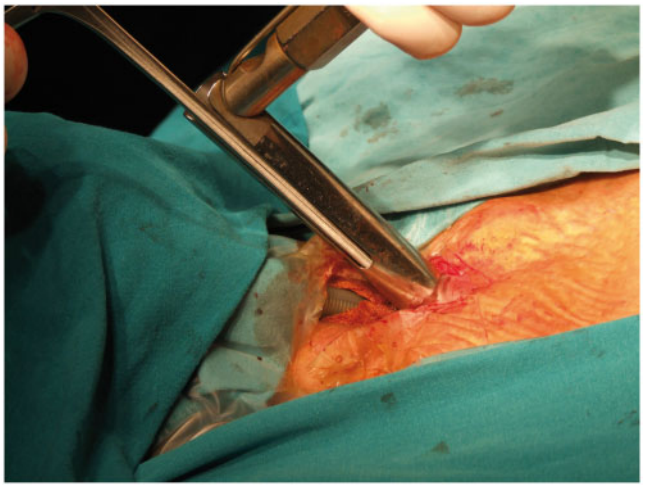

Figure 4: A mediastinoscope/video mediastinoscope was inserted through the pretracheal fascia.

Figure 5: Image of the early postoperative mediastinoscopy incision.

nodes (4R), subcarinal lymph nodes (7), left lower paratracheal lymph nodes (4L) and left upper paratracheal lymph nodes (2L) regularly. The same procedure was performed in patients with tracheostomy.

A horizontal incision ∼5 to 10 mm below the tracheostomy stoma was made, and a mediastinoscope/videomediastinoscope was inserted through the pretracheal fascia (Fig. 4). After sampling the mediastinal lymph nodes and haemorrhage control, the surgical wound was closed and then the patient was extubated (Fig. 5).

Statistical analyses

Statistical analyses were performed using SPSS software (Released 2013; IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY, USA: IBM Corp.). Descriptive statistics were used to calculate the mean values.

RESULTS

Cervical mediastinoscopy was performed in 18 patients with permanent tracheostomy after total laryngectomy. The study population consisted of only male patients with an average age of 61.2 years [standard deviation (SD) 7.3, range 47–74]. The mean time interval between total laryngectomy and mediastinoscopy was 56 months (SD 30). Secondary primary lung carcinomas after laryngeal carcinoma were detected on the right side in 8 cases (44%), left side in 9 cases (50%) and bilaterally in 1 case. These consisted of squamous carcinoma in 12 cases (67%) and adenocarcinomas in 6 cases (33%). Squamous carcinoma was significantly more common than adenocarcinoma ($P = 0.001$). The clinical characteristics of the patients are listed in Table 1.

The mean operative time was 63 min (SD 12.0, range 50–90). Upon histopathological examination, carcinoma metastasis was detected in 4 (22%) of the 18 patients who underwent cervical mediastinoscopy. Of these 4 patients, 3 had 1 carcinoma metastatic station and 1 had multiple stations. EBUS was performed in 7 of the 18 patients and did not detect any carcinoma metastasis on histopathological examination. In 3 patients with EBUS-negative pathology results, cervical mediastinoscopy detected carcinoma metastases. The negative predictive value of EBUS was 57% (4/7).

Fourteen patients had PET-positive mediastinal lymph nodes. Mediastinoscopy was also performed in patients with

Table 1: Patient demographics and detailed clinical data

Patient	Age (years)	Gender	Interval between MDX and tracheostomy (months)	PET positive lymph node station	EBUS	Postoperative oncology treatment	Preoperative diagnosis	2R	2L	4R	4L	7	Mediastinoscopy pathology	Operation time (min)
1	64	Male	8		P	4 CT + RT	Right lung CA			+	-	-	Carcinoma	55
2	66	Male	110	4R, 4L	P	6 CT + RT	Left lung CA	-		-	+	-	Carcinoma	65
3	63	Male	121	7	N	6 CT + RT	Left lung CA	-	-	-	-	-	Negative	65
4	52	Male	62	4R, 7	P	5 CT + RT	Right lung CA			+	+	-	Carcinoma	50
5	63	Male	59	4R	N	4 CT + RT	Right lung CA	-		-		-	Negative	55
6	61	Male	38	Hiler, 7	P	6 CT + RT	Bilateral syncronous CA		-	-	-	-	Negative	55
7	59	Male	32	Hiler, 4R	N	4 CT + RT	Right lung CA			-		-	Negative	50
8	66	Male	51	4R, 7	N	5 CT + RT	Right lung CA			+	-	-	Carcinoma	55
9	74	Male	49		N	6 CT + RT	Left lung CA					-	Negative	65
10	62	Male	62	4R, 4L	P	4 CT + RT	Left lung CA			-	-	-	Negative	55
11	50	Male	40	7	N	5 CT + RT	Left lung CA			-	-	-	Negative	50
12	47	Male	25	7	N	6 CT + RT	Left lung CA			-	-	-	Negative	60
13	53	Male	61	4R, 7	N	4 CT + RT	Left lung CA		-	-	-	-	Negative	65
14	61	Male	46	7	N	5 CT + RT	Left lung CA			-	-		Negative	90
15	67	Male	44	4R	P	5 CT + RT	Right lung CA			-			Negative	55
16	74	Male	25	4L	N	4 CT + RT	Left lung CA	-		-	-	-	Negative	85
17	59	Male	85	4R	N	5 CT + RT	Right lung CA			-	-	-	Negative	80
18	61	Male	94		P	4 CT + RT	Left lung CA			-	-	-	Negative	70

CA: carcinoma; CT: chemotherapy; EBUS: endobronchial ultrasonography; 2L: left upper paratracheal lymph node; 4L: left lower paratracheal lymph node; MDX: mediastinoscopy; N: not performed; P: performed; PET: positron emission tomography; 2R: right upper paratracheal lymph node; 4R: right lower paratracheal lymph node; RT: radiotherapy; 7: subcarinal lymph node.

PET-negative lymph nodes that had smallest diameter >1 cm in CT scans. No carcinoma metastasis was seen in these 4 patients after mediastinoscopy. PET-CT had a positive predictive value of 20% [3/15, confidence interval (CI) 12.0–31%] and a negative predictive value of 67% (2/3, CI 19–94%). Histopathological examination detected a positive subcarinal lymph node after anatomical lung carcinoma surgery in 1 patient whose mediastinoscopy result was negative. The negative predictive value of cervical mediastinoscopy was 93% (1/14, CI 69–99%). Main complications of mediastinoscopy were hoarseness, haemorrhage and wound infection. No major haemorrhage was reported. Hoarseness could not be evaluated because all patients had tracheostomy. One patient had seroma as wound infection which was the only complication that occurred in 18 patients. There were no other major or minor complications and neither perioperative nor postoperative mortality.

DISCUSSION

The annual risk for a second primary tumour following a laryngeal carcinoma is 1–7%, which persists for at least 10 years. Significant proportions of secondary malignancies develop in the oesophagus and lungs [1]. Sixty-four percent of patients with laryngeal carcinoma receive chemoradiotherapy after laryngectomy in the postoperative stage [7]. In the present study, all patients received postoperative chemoradiotherapy after laryngectomy.

The most appropriate strategy for treating mediastinal lymphadenopathy after total laryngectomy remains controversial. Non-invasive methods are generally inadequate to diagnose these lymphadenopathies. An accurate histopathological diagnosis of newly emerging mediastinal lymphadenopathy is essential because of the possibility of recurrent laryngeal carcinoma or secondary primary lung carcinoma [5]. Previous laryngectomy and permanent tracheostomy result in challenging conditions for cervical mediastinoscopy. Therefore, there is controversy regarding the applicability of cervical mediastinoscopy in patients with tracheostomy after laryngectomy, with some authors insisting that previous tracheostomy is a contraindication for cervical mediastinoscopy [4, 6]. Here, we described cervical mediastinoscopy performed in 18 patients with permanent tracheostomy after total laryngectomy that had mediastinal lymphadenopathy due to secondary primary lung carcinoma.

Previous reports have suggested that the mediastinum should be evaluated by CT and PET-CT [8, 9]. CT remains important in lung cancer imaging. However, due to its low sensitivity of 55% and specificity of 81%, it is not possible to rely solely on CT results. The addition of PET to CT results in more accurate lymph node staging than CT alone with an overall sensitivity of 74–90% and specificity of 69–95%. Despite mediastinal negativity in PET images, cervical mediastinoscopy was performed in cases with suspected hilar (N1) and mediastinal lymph nodes (N2), centrally located tumours without suspected nodes in CT scans or PET-CT and potential pneumonectomy candidates [3, 10].

Patients with a permanent tracheostomy after total laryngectomy received postoperative radiotherapy. The positive predictive value of PET-CT was 3/15 (20%). This low value may have been due to the presence of secondary fibrosis and inflammation occurring after tracheostomy and radiotherapy. Therefore, in this group of patients, PET-positive lymph nodes should not be considered N2 disease before histopathological confirmation. The negative predictive value of PET-CT was 2/3 (67%).

EBUS is a less-invasive diagnostic method than surgery and frequently used when radio-imaging methods are inadequate. EBUS

is an alternative technique for thoracic malignancy staging and for assessing mediastinal lymphadenopathy and is superior to radiographic staging techniques. Based on a comparison of studies from several major centres, it was concluded that EBUS has a sensitivity, specificity and accuracy of 88–99%, 100% and 96–99%, respectively [11]. Vincent *et al.* [12] reported that surgical staging procedures were avoided in 43% of patients who underwent EBUS. Generally, EBUS articles present standard patients who do not have tracheostomy and did not receive radiotherapy. The sensitivity and specificity of EBUS/endoesophageal ultrasound are presented as 50% and 60%, respectively, in patients who received radiotherapy and chemotherapy. It is also stated that chemotherapy and radiotherapy treatment modality decreases EBUS' accuracy due to fibrosis and necrosis. EBUS' positive predictive value is presented as below 33%. In our study, EBUS' accuracy rates are low correlatively [13]. The sensitivity and specificity of EBUS are currently unknown in patients with laryngectomy receiving radiotherapy. In the present study, EBUS showed a negative predictive value of 57%. This low value may have been due to fibrosis after radiotherapy and also tumour necrosis after chemotherapy.

The most important feature distinguishing 'cervical mediastinoscopy for patients with permanent tracheostomy after laryngectomy' from 'regular mediastinoscopy' is the incision type, because tracheostomy stoma is present in the regular mediastinoscopy surgical area. The mediastinoscopy incision for patients with tracheostomy should be ∼5 to 10 mm below the tracheostomy stoma, and the incision should not disrupt the integrity of the stoma. Compared to standard mediastinoscopy, sampling 2R and 2L were more time-consuming. Dissection appeared to be controversial in upper cervical regions where 2R and 2L are present, due to radiotherapy affect. Accessing number 4R, 4L and 7 lymph node stations were easier compared to upper cervical lymph nodes. There was no difficulty in passing through the plane between the pulmonary artery and the subcarinal lymph nodes.

Mediastinal lymph node sampling is possible after meticulous dissection. Contrary to the claims of some sources, cervical mediastinoscopy is a viable method for patients with tracheostomy after laryngectomy [4, 6]. In the present study, cervical mediastinoscopy had a negative predictive value of 93%. This value was 94% in a previous local clinical study from the Third Surgery Clinic of Yedikule Chest Disease and Thoracic Surgery Hospital, Istanbul, Turkey [14]. Therefore, the negative predictive values of standard cervical mediastinoscopy and mediastinoscopy for patients with tracheostomy after total laryngectomy are approximately equivalent.

Our results indicate that cervical mediastinoscopy is a feasible method in patients with permanent tracheostomy when applied by experienced thoracic surgeons in specialized hospitals.

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The English in this document has been checked by at least 2 professional editors, both native speakers of English. For a certificate, please see: http://www.textcheck.com/certificate/ODlfbT.

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