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## Minimally-invasive complete resection of intrathoracic mediastinal lesions with a Linder-Dahan spreadable-blade video mediastinoscope system: A report of two cases



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### ABSTRACT

**INTRODUCTION:** Cervical mediastinoscopy can provide a minimally invasive access to the paratracheo-bronchial mediastinum within its reachable range, but its operability is substantially limited because of its small operative field, poor visualisation, and one-handed operation.

**PRESENTATION OF CASES:** Patient 1, a 56-year-old woman, presented with a 22 × 17 mm, non-symptomatic, <sup>18</sup>F-fluorodeoxy glucose (FDG)-avid, solid schwannoma originating from the vagus nerve trunk in the right upper paratracheal space. Patient 2, a 55-year-old man, presented with a 55 × 41 mm cystic mass in the left upper paratracheal space that extensively compressed and dislocated the trachea toward the right, which caused dyspnoea and cervicothoracic pain. The masses in both cases were completely resected using a Linder-Dahan spreadable-blade video mediastinoscope.

**DISCUSSION:** The addition of the video system and spreadable blades to the conventional scope combined with a scope-holding device has enabled effective bi-manual preparation and more precise and safer mediastinoscopic procedures than those performed using the conventional one-handed mediastinoscope. Owing to the improved operability, more complex or extended procedures could be performed in wider and more stable operative spaces with better visualisation, although the system has the same minimal invasiveness as that of the conventional mediastinoscope.

**CONCLUSION:** We describe two patients with mediastinal lesions that were effectively resected by using this sophisticated video mediastinoscope system.

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## 1. Introduction

Cervical mediastinoscopy can provide minimally invasive access to the *para*-tracheobronchial mediastinum within its reachable range, but its operability is substantially limited because of its narrow operative field, poor visualisation, and one-handed operation [1]. The invention of the Linder-Dahan video mediastinoscope (VM) with the addition of a video system and spreadable blades to the conventional scope combined with a scope-holding device has enabled effective bimanual preparation and much safer and more precise procedures than those performed using the conventional mediastinoscope. Owing to the improved operability, more complex or extended procedures could be performed in wide and stable operative spaces, with excellent visualisation, although the sys-

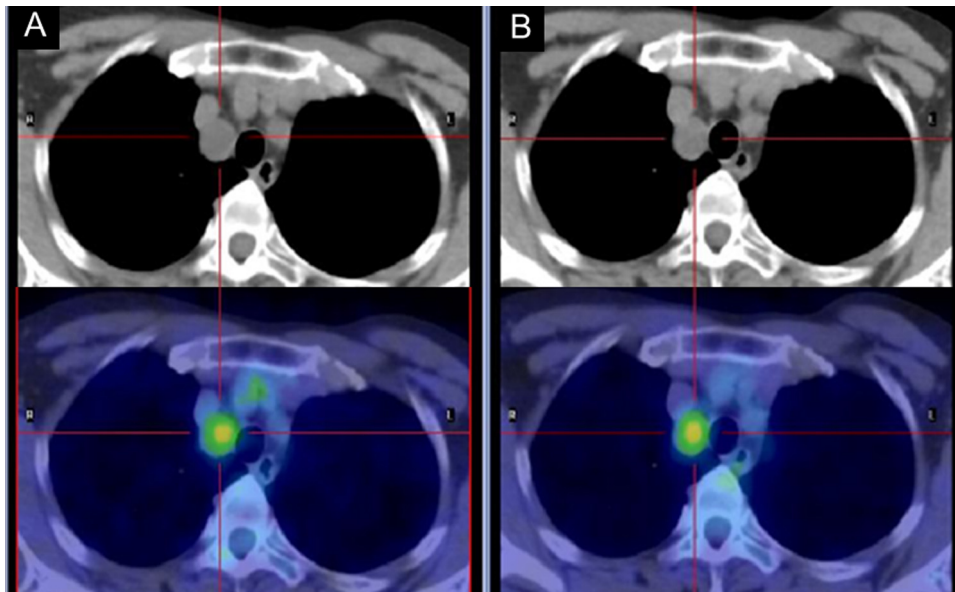
tem has the same minimal invasiveness as that of the conventional mediastinoscope.

## 2. Presentation of cases

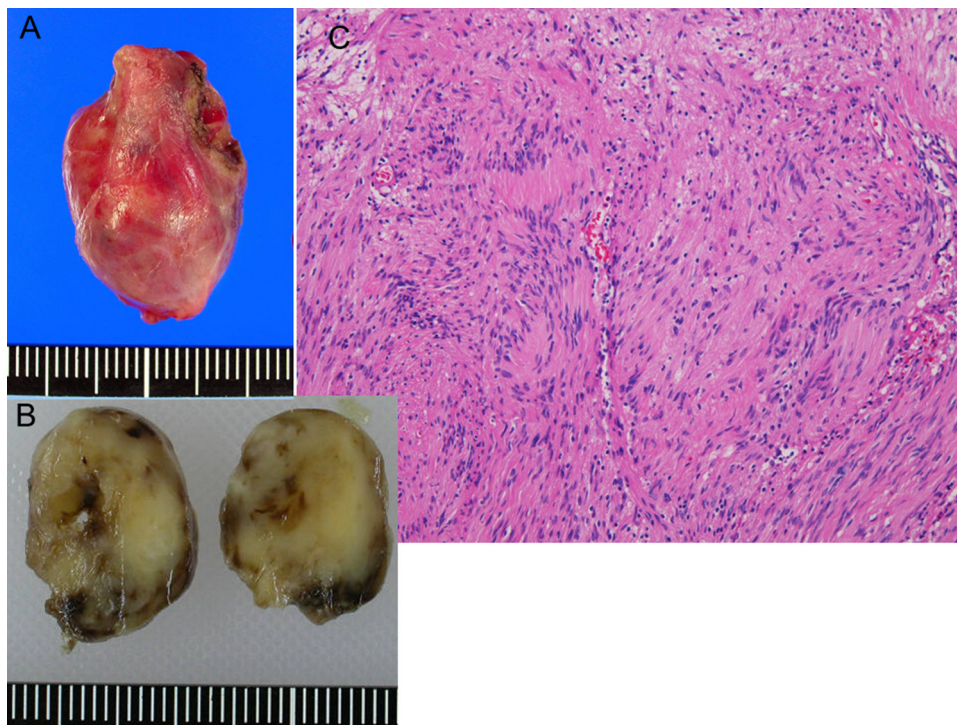
### Case 1

Patient 1 was a 56-year-old woman who presented with a 22 × 17 mm, non-symptomatic, solid mass in the right upper paratracheal space, which was detected by chance. <sup>18</sup>F-Fluorodeoxyglucose positron emission tomography/computed tomography (<sup>18</sup>F-FDG-PET/CT) demonstrated solitary FDG uptake to the mass, with a maximum standardised uptake value of 3.2 both in the early and delayed phases (Fig. 1). The procedural simulation of the resection was preoperatively studied by creating animated, three-dimensional (3-D), virtual mediastinoscopic images reconstructed based on <sup>18</sup>F FDG-PET/CT data in two mutually complementary demonstration modes, namely the tracheobronchial and vessel modes [2]. The virtual mediastinoscopic

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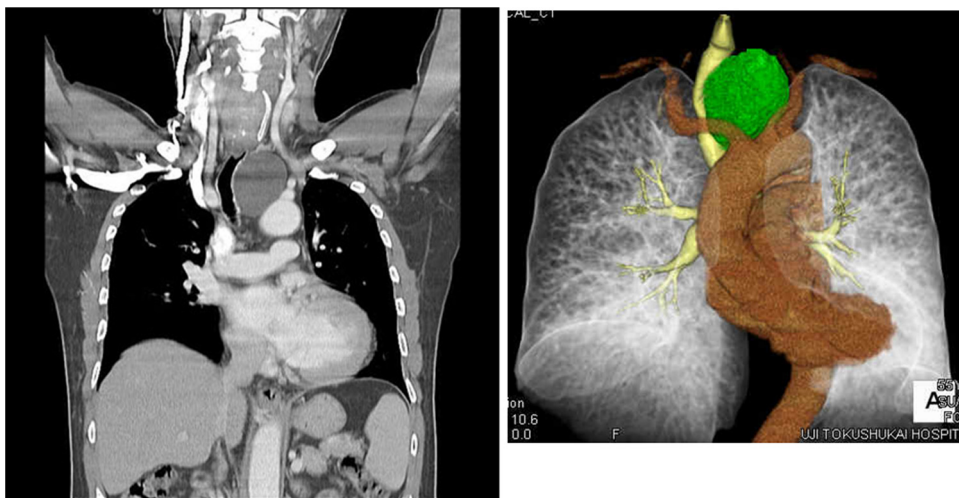
**Fig. 1.** The chest computed tomographic image shows a 2-cm, solid, clearly margined mass that mimicked station #2R lymph node swelling. The  $^{18}\text{F}$ -fluorodeoxyglucose (FDG) positron-emission tomography/computed tomographic image shows the single, moderate FDG uptake to the mass. The maximum standardised uptake value (SUV max) is 3.2 in both the early (A) and delayed phases (B).



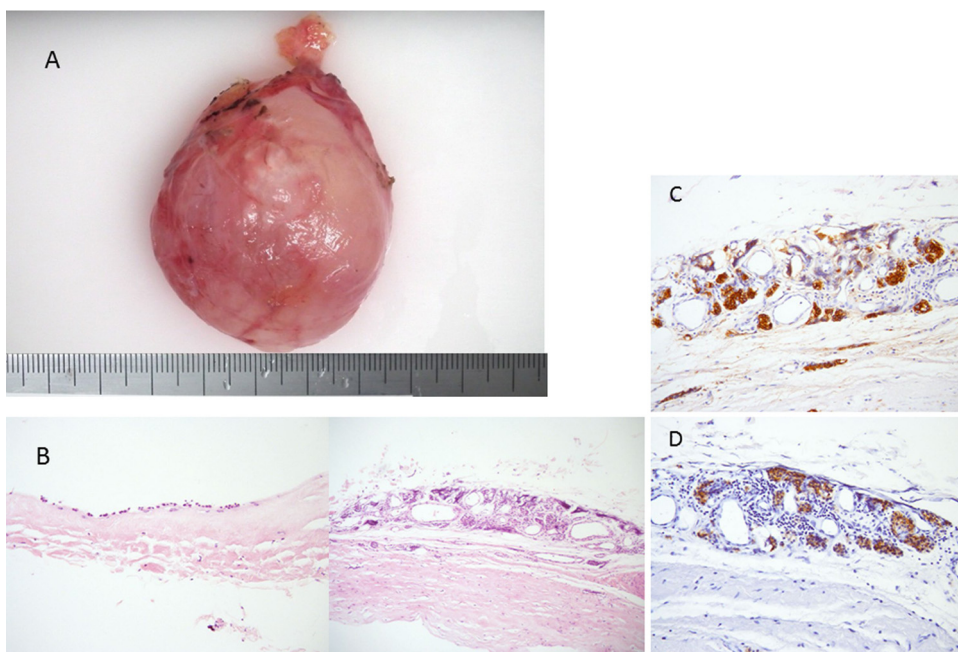
**Fig. 2.** Resected specimen of the right paratracheal tumour (A: macroscopic, not fixed; B: macroscopic, fixed; and C: microscopic). The histologically confirmed benign schwannoma consists of Antoni type A and B spindle cells.

image coherently demonstrated the tumour location just caudal to the innominate artery and immediately distal to the origin of the right recurrent laryngeal nerve. After histological diagnosis as a schwannoma originating from the vagus nerve trunk, the mass was completely resected by using the Linder-Dahan VM system (model 8783.401; Richard Wolf, Knittlingen, Germany). The mass was bi-manually dissected from the surrounding tissue along the extra-capsular layer, and both vagal trunks proximal and distal

to the mass were clipped and divided (Supplementary Video 1 in the online version at DOI: [10.1016/j.ijscr.2016.05.002](https://doi.org/10.1016/j.ijscr.2016.05.002)). Attention was paid to preserve the right recurrent laryngeal nerve (Fig. 2). No drainage tube was placed. The patient had an uneventful postoperative course without vocal cord palsy or deficit symptoms of the right vagus nerve.



**Fig. 3.** Chest computed tomographic image showing the 55- × 41-mm cystic mass in the left upper paratracheal space that extensively compressed and dislocated the trachea toward the right. The mass is incarcerated between the trachea and aortic arch.



**Fig. 4.** Resected specimen of the left paratracheal cyst (A: macroscopic; B: microscopic, haematoxylin-eosin stain; C: microscopic, AE3/AE5 stain; and D: microscopic, CK19 stain). Histological assessment confirmed a parathyroid cyst with parathyroid tissue that was immunohistochemically positive for AE3/AE5 and CK19 in its surrounding tissue.

### Case 2

Patient 2 was a 55-year-old man who presented with a 55- × 41-mm cystic mass in the left upper paratracheal space that extensively compressed and dislocated the trachea toward the right, causing symptoms, including cough, cervicothoracic pain, and dyspnoea. The large cystic mass was incarcerated between the trachea and aortic arch (Fig. 3). At the onset of general anaesthesia, endotracheal intubation was performed after decompression of the cyst by paracentesis. By using the Linder-Dahan VM system, through a single 2.5-cm cervical incision and under video guidance, the entire cyst wall was bi-manually dissected from the surrounding tissue in the stable space created by the opened blades and was completely resected almost without rupture (Supplementary Video 2 in the online version at DOI: [10.1016/j.ijscr.2016.05.002](https://doi.org/10.1016/j.ijscr.2016.05.002)). No drainage tube was placed. After the resection, the symptoms

caused by the compression of the cyst disappeared. Histological assessment confirmed a parathyroid cyst with parathyroid tissue that was immunohistochemically positive for AE3/AE5 and CK19 in its surrounding tissue (Fig. 4). The patient had an uneventful postoperative course.

### 3. Discussion

Since it was first described by Carlens [3] in 1959, standard cervical mediastinoscopy has been widely used for minimally invasive biopsy of paratracheal and subcarinal lymph nodes, and retrovascular mediastinal tumours. In the management of patients with lung cancer, mediastinoscopy plays a fundamental role in both diagnosis and staging [4]. As far as the resection of paratracheal masses is concerned, however, the conventional equipment for cervical mediastinoscopy is incompetent, permitting only



**Fig. 5.** The Linder-Dahan video mediastinoscope (A: with its blades closed; B: with its blades opened; C: attached to the scope-holding device; D: bi-manual procedures through the scope).

one-handed surgical manoeuvres through a tight operative channel, which the surgeon can only view through a mediastinoscope [1]. The development of the Linder-Dahan VM system with a scope-holding device, which is a novel mediastinoscope, has overcome these deficits. It has enabled surgeons to perform complex bi-manual procedures, including complete resection of mediastinal tumours and even bronchial closure using staplers [5]. The attachment of spreadable blades to the video mediastinoscope combined with a scope-holding device allows for effective, delicate bi-manual procedures in wide and stable operative spaces in the deep mediastinum, with the insertion of several 5-mm endoscopic instruments, enabling optimal exposure of the mediastinal structures (Fig. 5) [6]. Furthermore, digital video imaging has increased the sensitivity, safety, and confidence in performing detailed mediastinal exploration with enlarged images on the screen [7]. Bi-manual procedures can be easily executed, using one hand to extract the tissue and the other hand for clipping to control minor bleeding or lymphatic leakage, cutting with scissors, or performing electric coagulation [8]. Without the use of the Linder-Dahan VM system, the schwannoma/parathyroid cyst of the two patients presented herein could not be successfully and effectively resected. Compared with video-assisted thoracoscopic surgery (VATS) [9], the minimally invasive resection of mediastinal masses with the use of this system includes the advantages that separate lung anaesthesia and shifting between the supine and lateral decubitus positions are unnecessary. In particular, the system should be more beneficial for patients with possible pleural adhesions or poor pulmonary function that does not allow separate lung ventilation [1,7]. Compared with VATS, this system also has the advantages of better access to the lesions in the cervicothoracic border and left paratracheal space [9].

Since 2002, Hürtgen and associates have applied this system to systematic mediastinal lymph node dissection (video-assisted

mediastinal lymphadenectomy [VAMLA]) of lung cancers, with complete resection of all lymph node components in the subcarinal space and both paratracheal spaces, and demonstrated its technical feasibility and increased sensitivity [6]. The Linder-Dahan VM system is a prerequisite for VAMLA.

In Patient 1, the paratracheal mass showed FDG avidity on PET/CT, and the dynamic 3-D  $^{18}\text{F}$  FDG-PET/CT virtual mediastinoscopy animation could be preoperatively reconstructed based on  $^{18}\text{F}$  FDG-PET/CT data, with accurate representation of actual mediastinoscopic procedures. This preoperative simulation of the procedure by using virtual mediastinoscopy was useful for better anatomical understanding of the spatial interrelationship between the FDG-avid mass and the mediastinal structures, improving procedural safety and confidence, as we previously reported [2]. Regarding Patient 1, to our knowledge, this is the first report in English on mediastinoscopic resection of a paratracheal, intrathoracic vagal schwannoma.

The minimally invasive cervical mediastinoscopy under the Linder-Dahan VM system is thus no longer a simple technique reserved for mediastinal nodal biopsy for lung cancers; it has huge potential for application in more-advanced procedures such as bronchial fistula closure or extended vascular or tracheobronchial procedures [5]. This technological evolution has widened the therapeutic spectrum, setting a new horizon for minimally invasive mediastinoscopic treatment.

#### 4. Conclusion

We described two patients with mediastinal lesions that were effectively resected by using the Linder-Dahan VM system. This system has enabled the performance of more-complex procedures in wide and stable operative spaces, with better visualisation but

still with the same minimal invasiveness as that of conventional mediastinoscopy.

#### Conflicts of interest

All authors declare that they have no conflict of interest.

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This case report is realized without any funding.

#### Ethical approval

The publication of this case report has been approved by ethical committee (IRB) of UjiTokushu-kai Hospital since March 11th, 2016.

#### Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

#### Author contribution

Hideki Itano performed the surgery and drafted the manuscript. Other authors revised and approved the manuscript.

#### Guarantor

Hideki Itano.

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