Prevertebral cervical approach: a pure endoscopic surgical technique for posterior mediastinum parathyroid adenomas

Juan Manuel Martos-Martínez[1] · Cristina Sacristán-Pérez[1] ·
Marina Pérez-Andrés[1] · Virginia María Durán-Muñoz-Cruzado[1] ·
Verónica Pino-Díaz[1] · Francisco Javier Padillo-Ruiz[1]

Abstract

Background Parathyroid gland mediastinal ectopia is an unusual but challenging condition in surgical management of hyperparathyroidism. Posterior mediastinum parathyroid ectopia is rare, and glands need to be removed either with a broad open cervical or thoracic approach. In recent years, several minimally invasive approaches to mediastinal parathyroid glands have been described, but for posterior mediastinum adenomas, proposed techniques are transthoracic.

Methods The aim of this paper is to describe, to our best knowledge for the first time, a standardized pure endoscopic cervical technique to approach posterior mediastinal parathyroid adenomas which we have used in three patients.

Results The technique was applied in three patients which excellent surgical, postoperative, and cosmetic results.

Conclusions Endoscopic prevertebral approach is a feasible, sure and inexpensive standardized pure endoscopic cervical approach to posterior mediastinal parathyroid adenomas, which may result in a less aggressive surgical option when compared with thoracic approaches.

Keywords Parathyroid gland ectopia · Posterior mediastinum · Endoscopic surgical treatment · Parathyroidectomy

✉ Juan Manuel Martos-Martínez
jmmartos66@gmail.com

1 General and Digestive Surgery Department, Virgen del Rocío University Hospital, Avda, Manuel Siurot S/N, 41013 Seville, Spain

Parathyroid gland mediastinal ectopia is an unusual but challenging condition in surgical management of hyperparathyroidism. Posterior mediastinal parathyroid glands are believed to result from inferoposterior migration of the superior parathyroid glands and can be a rare cause of ectopic parathyroid tissue [1].

The mediastinum is bounded superiorly by the thoracic inlet and inferiorly by the diaphragm. For clinical purposes, the mediastinum has traditionally been divided into the anterior (or anterosuperior), middle, and posterior compartments. There are no fascial planes between these divisions, and they are in continuity with each other. Thus, tumors can exist in more than one compartment. The anterior mediastinum lies between the sternum and the pericardium. It contains the thymus, lymph nodes, and loose connective tissue. The middle mediastinum contains the heart, the proximal great vessels, phrenic nerves, trachea, and main bronchi. The posterior mediastinum lies posterior to the pericardium and anterior to the thoracic vertebrae. It contains the esophagus, descending thoracic aorta, azygos vein, thoracic duct, and autonomic ganglia [2].

Most of posterior mediastinum parathyroid ectopia can be removed either with an open cervical or thoracic approach. However, a large incision and an extensive dissection are usually required. This occurs especially in obese patients or in cases with previous neck surgery.

In recent years, several minimally invasive approaches to mediastinal parathyroid gland have been described [3–22]. Cervical endoscopic or video-assisted approaches refer to anterior mediastinum adenomas. When focusing in posterior mediastinum adenomas, proposed techniques are always transthoracic, with a minimal open incision or by minimally invasive video-assisted thoracoscopy. Robotic assistance has also been referred in recent publications [23–26].

Cervical approach is a more familial surgical field for Endocrine General Surgeons. Its endoscopic performance may result in a less aggressive surgical option when compared with thoracic approaches due to the lack of pleural incisions. Besides, cervical approach carries out an easier patient management for anesthesiologists, as selective bronchial intubation is not needed.

The aim of this paper is to describe a feasible, sure and inexpensive standardized pure endoscopic cervical approach to posterior mediastinal parathyroid adenomas.

Materials and methods

Patients

Three consecutive patients were operated. Institutional protocols were strictly followed and patients gave explicit informed consent both for surgery and endoscopic approach. All patients were female, with age of 49, 56, and 69 years. Biochemical diagnosis of primary hyperparathyroidism was established, and surgery was indicated in two patients according to the ASBMR Guidelines for the Management of Asymptomatic Primary Hyperparathyroidism [27] (New Guidelines were not yet published at the moment of surgery). These two younger patients (cases 2 and 3) were morbidly obese, whit BMI of 45 and 56 kg/m^2 respectively.

The older patient (case 1), had underwent a previous total thyroidectomy for multinodular goiter and total parathyroidectomy without auto-transplantation for secondary hyperparathyroidism, attended at other institution. This patient presented a recurrent hyperparathyroidism whit surgical indication.

Neck ultrasonography and Tc-99 m-MIBI dual-phase scintigraphy with SPECT/CT imaging were performed in all three patients, demonstrating in all cases a single gland disease on the right side of posterior mediastinum, at Th3-Th4 vertebral level (Fig. 1).

Surgical technique

The surgical intervention is performed under general anesthesia and tracheal intubation. Antibiotic and antithrombotic prophylaxis was used in all patients.
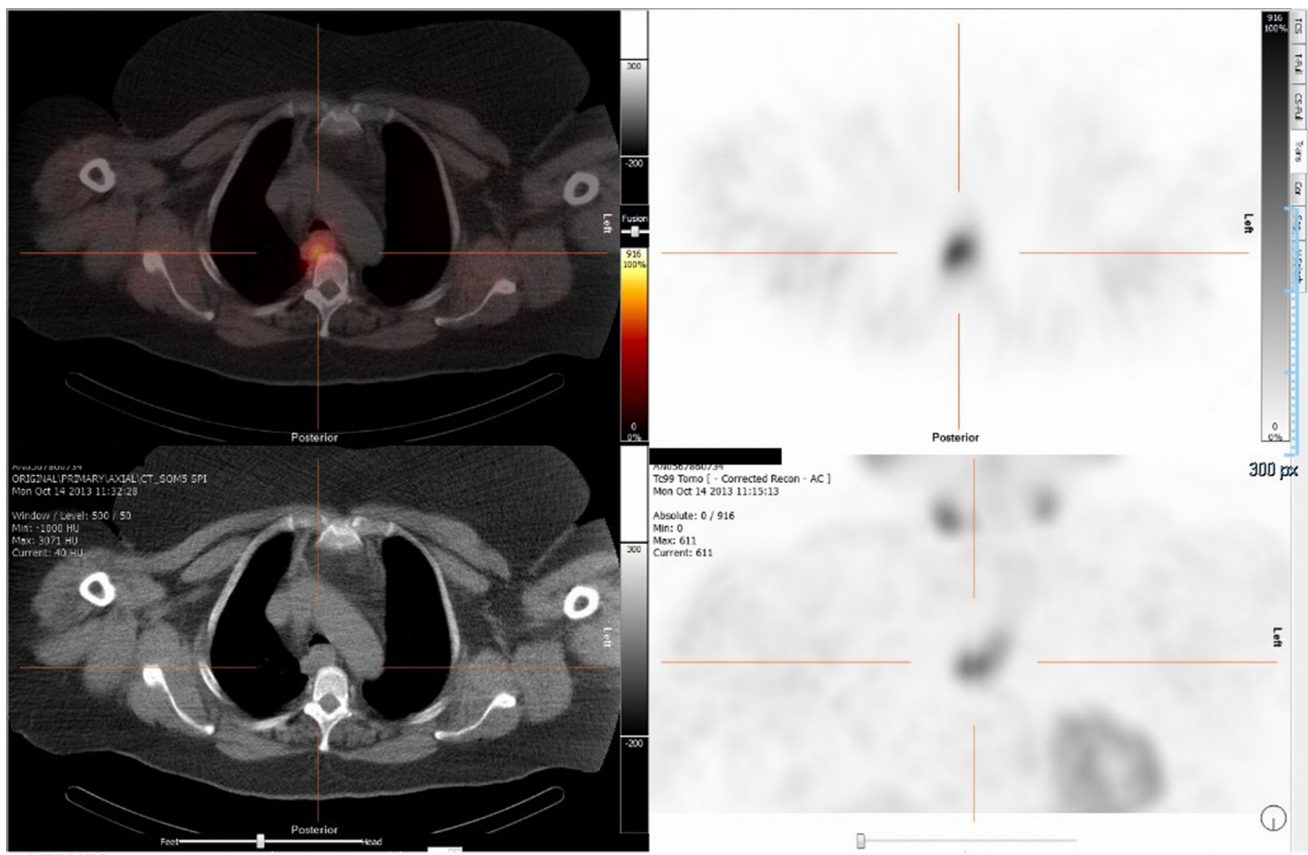

Fig. 1 Tc-99 m-MIBI dual-phase scintigraphy with SPECT/CT imaging (case 2)

Step 1: Team disposition and patient placement

The surgeon is located at the head of the patient on the right side and the assistant stands on the left. The scrub and instruments table is placed on the right side of the surgeon. Monitors are placed in front of surgeon at the left side of the patient, at patient's abdomen level (Fig. 2).

The patient is placed in a position of slight hyperextension of the neck, and the head is slightly rotated to the opposite side of intervention (Fig. 3).

Step 2: Creating the working space

A 11-mm incision is made at midway between sternal knot and mastoid. Electro-cautery and shears dissection is performed to open a plane between carotid sheet and prethyroidal muscles and esophagus. Once the anterior aspect of cervical spine is reached, blunt digital dissection is used to extend retro-esophageal dissection (Fig. 4).
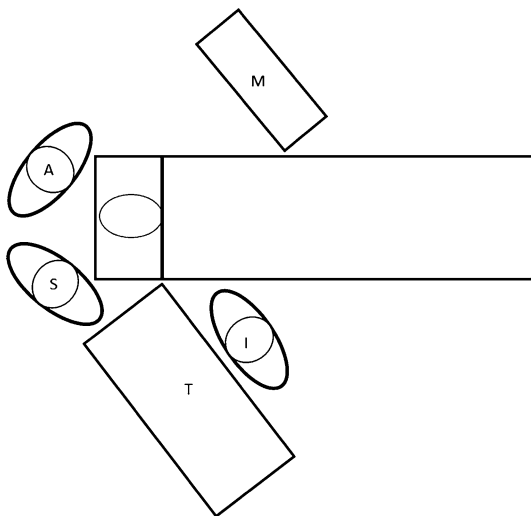

Fig. 2 Team disposition in operating room (*S* Surgeon, *A* Assistant, *I* Instrumentalist, *T* Instruments table, *M* monitor-display)
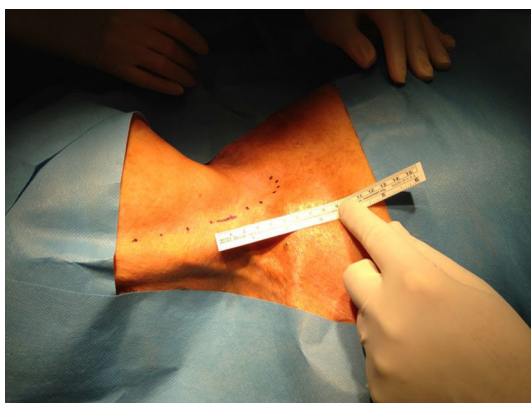

Fig. 3 Patient disposition and landmarks (case 1)

Step 3: Trocar placement

Three trocars are placed on anterior sternocleidomastoid muscle relief. At this point, two 5-mm trocars, or a 2.8 mm and a 5 mm trocar, are placed under digital control in the space between carotid sheet an prethyroidal muscles, 3–4 cm up (port 1, left hand) and down (port 2, right hand) previous incision, to slightly reach the previously dissected virtual space. Then, a 11-mm trocar (port 1, optics and extraction) is putted on place reaching the same space (Fig. 5). At this point, a 15 mmHg CO_2 pneumomediastinum is slowly established (3 l/min).

Step 4: Mediastinal dissection

A 5 mm in diameter, 0° and 20 cm in length fiberoptic endoscope is introduced through port 1, a 2.8 or 5 mm atraumatic grasper trough port 2 and a Ligasure® dolphin tip 5 mm diameter and 20-cm-length instrument (Covidien, Covidien plc 20, Lower Hatch Street Dublin 2, Ireland) through port 3.

Using both instruments, blunt dissection is performed to extend the dissection deeper on the thorax, using as references the esophagus on the left side and carotid artery in the
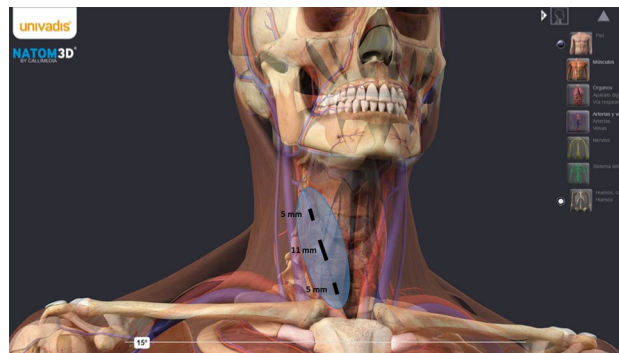

Fig. 4 Trocar placement and blunt prevertebral dissection zone (modified on images from NATOM3D from Callimedia®, under permission of Univadis©)
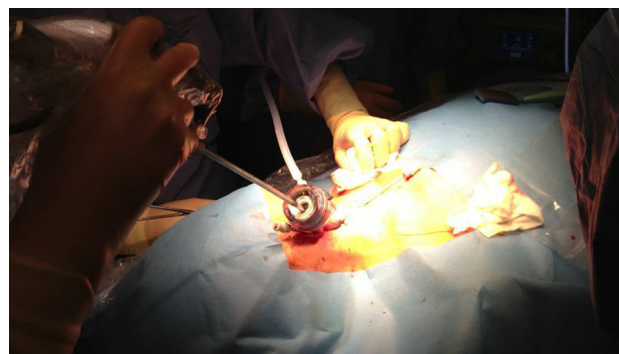

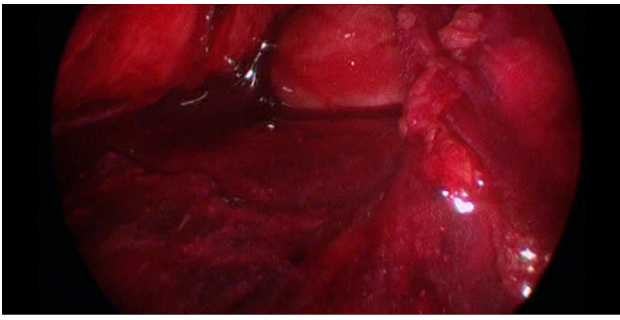**Fig. 5** Trocar disposition (case 1)

Fig. 6 Identification of adenoma (case 3)

Fig. 8 Removal of the specimen (case 1)

first centimeters on the right side and, later, the subclavian artery and brachiocephalic trunk on the anterolateral aspect of the surgical field. The dissection is progressed on this way till parathyroid adenoma relief is visualized (Fig. 6).

In the first case, we used as port 1 a 2.8-mm trocar and grasper, but we changed later to 5-mm instruments due to the fact that they allow an easier and quicker handling of the gland. The rationale for the selection of the energy device includes a thin tip bipolar instrument which enhances the dissection and warrants surrounding tissue protection during sealing, avoiding risks related to unnoticed contacts of the external aspect of the active branch of ultrasonic sealing devices in a small virtual space.

Step 5: Gland dissection

The gland is mobilized by means of blunt dissection (Fig. 7). Vascular attachments are easily identified, sealed, and cut. So the gland is get free in the mediastinum.

Step 6: Gland removal

At this point, the fiberoptic endoscope is changed to port 2 or 3 and the grasper is pulled through port 1. Using gentle traction, the gland is brought to the 11-mm incision and easily removed (Fig. 8), lightly extending the incision if necessary.
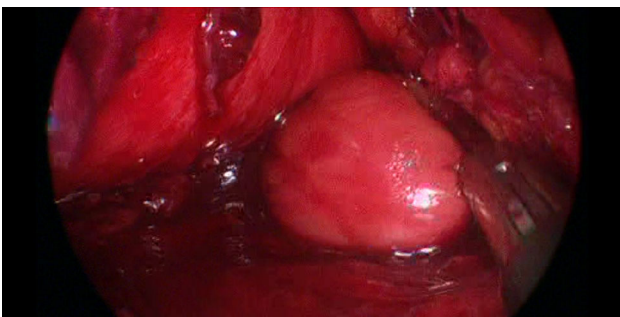
Step 7: Closure

Drainages are not used. Reabsorbable sutures are placed to close the gap between sternocleidomastoid and prethyroidal muscles at 11-mm incision. Subcuticular sutures and sterile strips are used to close skin wounds (Figs. 9, 10).

Fig. 9 Final aspect before closure (case 1)

Fig. 7 Dissection of the gland (case 3)

Fig. 10 Final aspect (case 3)

Results

No intraoperative adverse events occurred, neither related to pneumomediastinum, not due to the surgical technique. Mean operative time was 32 ± 7 min. Blood loss was virtually null.

Calcium levels at 20 h from surgery were normalized in all three cases. Two patients were discharged next day after surgery, with a slight lower cervical cutaneous emphysema as the only complaint. The remaining patient (reoperation for secondary hyperparathyroidism) was derived to Nephrologist.

Histology confirmed the preoperative diagnosis, with parathyroid adenomas weighing 2.6, 2.9, and 3.7 g, respectively. Posterior revisions confirmed a satisfactory evolution and the cure of the disease.

Discussion

Endoscopic parathyroid surgery has not reached a wide spread among endocrine surgeons [1]. Modern selective open approaches to hyperparathyroidism have diminished surgical aggressiveness and, for many surgeons, endoscopic accesses represent an unnecessarily accomplished approach.

Nevertheless, there is a group of patients who can clearly obtain benefits from an endoscopic approach.

Mediastinal parathyroid adenomas are uncommon and can usually be removed by an open cervical approach [2]. However, great incisions and extensive dissection are frequently required for gland identification and removal as gland allocation may be deep. Sternotomy and thoracotomy have been used likewise to remove these glands when a deeper localization or higher gland weigh was found [3–6].

Along last 20 years, diverse approaches have been proposed for mediastinal parathyroid gland adenomas, but cervical pure endoscopic approach has been rarely described [7] and details about a reproducible surgical technique for posterior mediastinum adenomas remain, to our best knowledge, undescribed.

Most of published papers focusing on this entity postulate open cervical or thoracoscopic approach, with a preferred use, in general, for the last one [10–16].

We had operated several anterior mediastinum parathyroid adenomas localized more than 6–7 cm from the sternal knot by means of endoscopic or video-assisted mediastinoscopy techniques. This previous experience encouraged us to adapt the endoscopic technique to posterior mediastinum.

The need for radioguided surgery and intraoperative parathyroid hormone monitoring has been advocated to assure good results with these minimally invasive approaches [17–21]. However, if preoperative localization is undoubted (Tc-99 m-MIBI dual-phase scintigraphy with SPECT/CT) and gland size is not very small, it may not be necessary.

Robotic techniques have been also postulated, and transthoracic approach is the preferred one. In spite of good results reported with these techniques, its use has not been widely spread, probably due to its more recent development, the lack of wide availability and its higher costs [23–26]. Besides, these techniques have the issue of longer operative times, usually larger than one and a half hour.

Possible limits for the described approach could be both small and very large adenomas. In our experience, most of superior parathyroid adenomas migrated to posterior planes of the neck and mediastinum have a considerable size. Besides, posterior mediastinum has an advantage when compared to anterior mediastinum, which is its virtually lack of fat tissue, even in obese patients, unlike anterior mediastinum, as we have seen in patients we have treated by means of both endoscopic anterior and posterior mediastinum approaches. If during surgery we were not able to find the adenoma, the guidance of an intraoperative oral endoscopic ultrasonography could be helpful. At this point, it is necessary to remark the relevance of a preoperative perfect knowledge of adenoma characteristics and location by means of Tc-99 m-MIBI dual-phase scintigraphy with SPECT/CT imaging.

However, may be that adenomas about 1 cm or less could be very hard to find. Probably, deep adenomas less than 1 cm may not be suitable for this approach, and radioguided VATS could be the best option. On the other hand, due to the narrow surgical field we can get, adenomas larger than 3–4 cm in transverse diameter probably could be very difficult to handle by means of the described approach, so perhaps VATS could be also the best option for these patients.

The cervical pure endoscopic approach proposed in this paper has shown, in our experience, a high feasibility and short surgical time, with excellent postoperative results regarding to patient comfort, length of stay and disease cure, offering besides a very reasonable proceeding costs.

Compliance with ethical standards

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