TECHNICAL NOTE

Endoscopic surgery of the parathyroid glands: Methods and principles

J.-M. Prades*, M. Gavid, A.T. Timoshenko, C. Richard, C. Martin

Service d’ORL et chirurgie cervico-faciale, CHU Nord, 42055 Saint-Étienne cedex 2, France

KEYWORDS
Parathyroid adenoma; Ultrasound scan; Sestamibi scintigraphy; Endoscopic parathyroidectomy

Summary Targeted endoscopic parathyroidectomy without gas insufflation is a relatively non-invasive means of discovering and resecting parathyroid adenomas in sporadic primary hyperparathyroidism. This standardized technique depends on the quality of the preoperative imaging: cervical ultrasound and sestamibi scintigraphy, and can be optimized by preoperative insertion of an ultrasound-guided “harpoon” and rapid peroperative parathyroid hormone analysis. Failure rates range between 1.7% and 4%.

© 2013 Elsevier Masson SAS. All rights reserved.

Introduction

Sporadic primary hyperparathyroidism (SPH) is a common endocrine disorder characterized by inappropriate parathyroid hormone (PTH) secretion by one or several parathyroid glands. The most frequent clinical and biological symptoms involve bone tissue (osteoporosis, bone pain) and kidneys (lithiasis, impaired creatinine clearance), but diagnosis is increasingly made on discovery of asymptomatic hypercalcemia. Incidence of such cases is estimated at one in 500 females and one in 1500 males [1,2].

Complete resection after precise identification of the pathologic tissue is the only treatment enabling symptom resolution and long-term cure [1,3]. Parathyroid surgery, however, is often difficult: the main cause of failure is non-detection of a single adenoma with unusual or even ectopic topography. The second cause of failure is overlooking multi-gland involvement with hyperplasia or double adenoma: a pathologic gland is diagnosed, but inappropriate PTH secretion persists or recurs, indicating residual pathologic parathyroid tissue [2].

SPH involves a single adenoma in 89% of cases, double adenoma in 4%, hyperplasia in 5.5% and parathyroid adenocarcinoma in less than 1% [2,3]. The rate of multi-gland parathyroid pathology ranges from 2.4% to 16% [2,4]. This high rate of benignity and histopathologic variability lead to two requirements: preoperative topologic analysis by cervical ultrasound and sestamibi scintigraphy [2,3,5], and relatively minimally invasive surgery — the latter presently consisting mainly in the endoscopic parathyroidectomy procedure first described by Paolo Miccoli, associated for some authors to rapid peroperative PTH assay [6,7]. This targeted strategy is increasingly replacing traditional exploration of the parathyroid migration areas by bilateral cervicotomy [1,2,6].

Surgical technique

Endoscopic parathyroidectomy without gas insufflation is performed under general anesthesia, with the patient in dorsal decubitus with the head in slight hyperextension as for
thyroid surgery. A medial transverse skin incision of 2 cm is made two finger-widths from the superior edge of the jugular notch of the sternum. An endoscopy exploration tunnel is performed, with opening of the median cervical line and identification of the trachea, sternothyroid muscle and also the isthmus of the thyroid gland. Once these have been identified, long (8 cm) Langenbeck retractors are positioned, with a medial retractor for the thyroid gland positioned toward the medial line and a lateral retractor for the sternocleidomastoid and sternothyroid muscles toward the exterior; the panoramic endoscope (3.5 mm diameter, 30° angle) can now be introduced in Cunéo and Loré’s “spider’s web” space, medially between the visceral axis and the common carotid artery, beating and clearly visible laterally. The principal surgeon stands to the patient’s right if right-handed, with the endoscope in his or her left hand and the active instrument in the right hand; the first assistant stands at the patient’s head, holding the Langenbeck retractors; the second assistant stands to the left, with the aspirator; all must have a free view of the video-screen. Three areas are successively explored: the first is at the base of the thyroid lobe, around all its facets, especially the inferior and lateral, but at all events forward of the presumed trajectory of the recurrent laryngeal nerve, which has yet to be located (Fig. 1). The parathyroid adenoma is usually purplish brown, with a light yellow fatty “cap”; easily detached from the thyroid tissue, in an extracapsular position, generally about 1 cm in size and more than 50 mg in weight (compared to a normal parathyroid gland of 5 mm and 50 mg).

The next step involves locating the inferior thyroid artery, which runs forward of the prevertebral scalene muscles, transversally from the posterior side of the common carotid artery to the lateral posterior side of the thyroid gland; identifying the inferior thyroid artery and trachea in the previous step helps now identify the recurrent laryngeal nerve itself, forward of the esophagus on the left and on a line equidistant between the inferior thyroid artery and the trachea on the right. This second area of exploration is intended to look for a hypothetical parathyroid adenoma in an inferior location (gland derived from P3, the third endobranchial pouch) under the transverse axis of the inferior thyroid artery (Fig. 2). This area may require hemostasis by clipping the medial thyroid vein or some inferior thyroid veins, so as to be free to shift the posterior side of the thyroid gland medially by means of the medial Langenbeck retractor. The third area of exploration is intended to look for a hypothetical parathyroid adenoma in a superior location (gland derived from P4, the fourth endobranchial pouch), above the transverse axis of the inferior thyroid artery. Zuckerkandl’s thyroid tubercle, a posterior extension to the thyroid gland found in almost 90% of cases, lies forward of the parathyroid gland and recurrent laryngeal nerve (Fig. 3). This entire exploration may be performed bilaterally via the one medial incision.

If no parathyroid adenoma is found, the gland is considered ectopic, and the superior thymic region has to be dissected in the first of the above areas; in the second, the regions lying behind the recurrent laryngeal nerve should be explored, especially to the right but also behind the esophagus; and in the third, the superior retropharyngeal space and, more rarely, the carotid bifurcation, hypoglossal nerve or cervical retrocarotid region.
Figure 3  Third exploration area: deep superior perinervous (≈ 3 cm before RLN entry in larynx), right side. 1) superior pole of right thyroid lobe; 2) superior thyroid artery and collateral branches; 3) medial thyroid vein controlled by clips on internal jugular vein (3′). ITA: inferior thyroid artery; ZT: Zuckerkandl’s thyroid tubercle; RLN: right recurrent laryngeal nerve; PA1: upper (P3) retro-lobular prenervous parathyroid adenoma; PA2: upper (P3) retro-lobular retronervous parathyroid adenoma.

Once the adenoma is located, it is essential to control the vascular pedicle of the affected gland by clipping and to ensure that the entire gland is resected: this is usually unproblematic during endoscopic resection, as visibility is generally excellent.

Inserting an ultrasound-guided harpoon in the adenoma on the day of surgery can help endoscopic location and save surgery time.

Discussion

Targeted and especially endoscopic parathyroidectomy depends on the quality of preoperative imaging, which is principally ultrasound and sestamibi scintigraphy. CT and MRI may be performed secondarily [1,3,5]. Inserting an ultrasound-guided harpoon in the adenoma preoperatively can improve traditional imaging.

Ultrasound has many advantages: no radiation exposure; precise 3D topography; and direct location, enabling fine-needle aspiration biopsy and PTH assay [2,4] or inserting an ultrasound-guided harpoon. It is moreover a quick and inexpensive examination (15% of the cost of sestamibi scintigraphy). The main drawback is the learning curve, which requires an experienced ultrasonographer [2—4]. Comparative studies showed that ultrasound discovers multi-gland pathology in 26% to 69% of cases, compared to 9% to 49% for sestamibi scintigraphy [2]. Another potential advantage is the ability to discover ectopic retropharyngeal or retro-esophageal cervical adenomas or even subcapsular intrathyroid adenomas, thanks to their specific ultrasound aspect [2].

Unlike CT, on the other hand, ultrasound is not able to explore the entire thymic fossa and mediastinum [2,3].

The sensitivity of sestamibi scintigraphy ranges from 64% to 88% for a single adenoma, but is just 44% for hyperplasia and 30% for double adenoma; the rate of false positives, moreover, is about 15% [2—4]. In a recent study, Kandil et al. reported 17% negatives on sestamibi scintigraphy, in 75% of which ultrasound suggested simple adenoma, with targeted parathyroidectomy being feasible in 86% [8].

The imaging algorithm for preoperative imaging in sporadic primary hyperthyroidism consists firstly in ultrasound, then mibi scintigraphy or CT if ultrasound has proved uninformative [2—4]: ultrasound locates the adenoma in the correct cervical quadrant with 72% sensitivity, 94% specificity and a positive predictive value (PPV) of 79%. If ultrasound proves uninformative, mibi scintigraphy can locate the adenoma in the correct cervical quadrant with

<table>
<thead>
<tr>
<th>Table 1  Schematic comparison of endoscopic versus classical parathyroidectomy.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Endoscopic parathyroidectomy</strong></td>
</tr>
<tr>
<td><strong>Thin without goiter</strong></td>
</tr>
<tr>
<td><strong>Without goiter</strong></td>
</tr>
<tr>
<td><strong>Precise targeting preferable</strong></td>
</tr>
<tr>
<td><strong>Slightly longer</strong></td>
</tr>
<tr>
<td><strong>Idem (≈ 90% cure)</strong></td>
</tr>
<tr>
<td><strong>Teaching ability</strong></td>
</tr>
<tr>
<td><strong>Scar quality</strong></td>
</tr>
<tr>
<td><strong>Postoperative comfort (pain)</strong></td>
</tr>
</tbody>
</table>
28% sensitivity, 98% specificity and 82% PPV; for CT, the values are respectively 75%, 91% and 69% [9].

Endoscopic parathyroidectomy without gas insufflation is the attitude of choice when preoperative imaging (ultrasound and sestamibi scintigraphy) is concordant [6,7]. The theoretical drawback is the risk of overlooking multi-gland involvement, present in a mean 10% of cases [2,3], although peroperative PTH assay can help avoid this [2]. Classically, exploring the four glands via cervicotomy ensures a cure rate of 96% to 98%, which is comparable to that of targeted surgery. A prospective study compared targeted surgery followed, in the same patients, by 4-gland exploration after ultrasound, sestamibi scintigraphy and rapid peroperative PTH assay: the potential failure rate was 16% [4]; in reality, targeted surgery failure ranges from 1.7% to 4% [2,3]. Multi-gland disease, with double adenoma or hyperplasia may be perfectly controlled using a medial endoscopic approach [6,7]. Failure of preoperative imaging detection does not contra-indicate endoscopic exploration [8]. Conversion from endoscopy to classic surgery is rare, given a learning curve estimated at 30 operations, and mainly related to anatomic particularities (obesity, goiter) or the particular topography of an ectopic adenoma (Table 1).

Inserting a harpoon at the end of an ultrasound-guided wire on the day of surgery is a classic means of detecting non-palpable tumors in breast pathology, and has recently been used with success in cervical pathology: the harpoon may be intra- or juxta-lesional, to target recurrent metastatic adenopathies or non-palpable branchial or thyroglossal cysts [10]. Our own practice is to position the harpoon on or immediately next to the adenoma. Recent experience in cervical pathology does not point to any particular complications, but the vascular-nervous relations of the parathyroids call for caution.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References