Langenbecks Arch Surg (2016) 401:953–963
DOI 10.1007/s00423-015-1362-3

ORIGINAL ARTICLE

Compliance with recommendations on surgery for primary hyperparathyroidism—from guidelines to real practice: results from an Iberian survey

Jesús Villar-del-Moral[1] · João Capela-Costa[2] · Antonio Jiménez-García[3] · Antonio Sitges-Serra[4] · Daniel Casanova-Rituerto[5] · José Rocha[6] · Juan Manuel Martos-Martínez[7] · Aitor de la Quintana-Basarrate[8] · Jorge Rosa-Santos[9] · Xavier Guirao-Garriga[10] · José Miguel Bravo-de-Lifante[11] · Óscar Vidal-Pérez[12] · Antonio Moral-Duarte[13] · José Polónia[14] · On behalf of the Iberpara Study Group

Received: 7 September 2015 / Accepted: 30 November 2015 / Published online: 19 December 2015

Abstract
Purpose Knowledge about compliance with recommendations derived from the positional statement of the European Society of Endocrine Surgeons on modern techniques in primary hyperparathyroidism surgery and the Third International Workshop on management of asymptomatic primary hyperparathyroidism is scarce. Our purpose was to check it on a binational basis and determine whether management differences may have impact on surgical outcomes.
Methods An online survey including questions about indications, preoperative workup, surgical approach, intraoperative adjuncts, and outcomes was sent to institutions affiliated to the endocrine surgery divisions of the National Surgical Societies from Spain and Portugal. A descriptive evaluation of the re-

This work was presented as Oral Communication at the 6th Workshop of the European Society of Endocrine Surgeons (ESES), May 28–30, 2015 in Varna, Bulgaria.

✉ Jesús Villar-del-Moral
jesusm.villar.sspa@juntadeandalucia.es

[1] Endocrine Surgery Division, Department of Surgery, Virgen de las Nieves University Hospital, Avenida de las Fuerzas Armadas, 2, 18014 Granada, Spain

[2] Endocrine Surgery Division, Department of Surgery, São João University Hospital, Alameda Professor Hernâni Monteiro, 4200-319 Porto, Portugal

[3] Endocrine Surgery Division, Department of Surgery, Virgen Macarena University Hospital, Avenida Doctor Fedriani, 3, 41009 Sevilla, Spain

[4] Endocrine Surgery Division, Department of Surgery, Hospital del Mar, Passeig Marítim, 25-29, 08003 Barcelona, Spain

[5] Endocrine Surgery Division, Department of Surgery, Marqués de Valdecilla University Hospital, Avenida Valdecilla, s/n, 39008 Santander, Spain

[6] Endocrine Surgery Division, Department of Surgery, Santa María University Hospital, Avenida Professor Egas Moniz, 1600-190 Lisbon, Portugal

[7] Endocrine Surgery Division, Department of Surgery, Virgen del Rocío University Hospital, Avenida Manuel Siurot, s/n, 41013 Sevilla, Spain

[8] Endocrine Surgery Division, Department of Surgery, Cruces University Hospital, Plaza de Cruces, 12, 48903 Barakaldo, Spain

[9] Head and Neck Surgery Service, Instituto Português de Oncologia (IPO) – Lisboa, R. Professor Lima Basto, 1099-023 Lisbon, Portugal

[10] Endocrine Surgery Division, Department of Surgery, Parc Taulí Hospital, Parc Taulí, 1, 08208 Sabadell, Spain

[11] Endocrine Surgery Division, Department of Surgery, Princesa University Hospital, Calle de Diego de León, 62, 28006 Madrid, Spain

[12] Endocrine Surgery Division, Department of Surgery, Clínic University Hospital, Carrer Villarroel, 170, 08036 Barcelona, Spain

[13] Endocrine Surgery Division, Department of Surgery, Santa Creu i Sant Pau University Hospital, Carrer de Sant Quintí, 89, 08026 Barcelona, Spain

[14] Hospital Santo Antonio, Largo Professor Abel Salazar, 4099-001 Porto, Portugal

sponses was performed. Finally, we assessed the correlation between the different types of management with the achievement of optimal results, defined as a cure rate equal or greater than the median of all interviewed institutions.
Results Fifty-seven hospitals (41 Spanish, 16 Portuguese) answered the survey. First-ordered imaging tests were neck ultrasound and sestamibi scan. Facing negative or non-concordant results, 44 % of surgeons ordered additional tests before first-time surgery, and 84 % before reoperations. When indicated, selective parathyroidectomy was an acceptable option for 95 % of institutions as first-time surgery and for 51 % in reoperations. Intraoperative parathormone measurements were used by 92 % of departments. The surgical outcomes were good in most institutions (median cure rate 97 %) and were influenced mostly by the presence of an endocrine surgery unit in the surgical department ($p = 0.038$).
Conclusions Practice of Iberian endocrine surgeons is consistent with current recommendations on surgery for primary hyperparathyroidism, with variability in some areas.

Keywords Primary hyperparathyroidism · Parathyroidectomy · Preoperative workup · Intraoperative adjuncts · Outcomes research · Survey

Introduction

Nowadays, in the armamentarium of the endocrine surgeon, there is a wide variety of imaging techniques, surgical approaches and intraoperative adjuncts for patients diagnosed with primary hyperparathyroidism (pHPT). In the absence of large-scale randomized studies addressing the long-term effects of surgical versus conservative management for pHPT, the recommendations derived from the positional statement of the European Society of Endocrine Surgeons (ESES) on modern techniques in pHPT surgery [1] and the Third and Fourth International Workshop on the management of asymptomatic primary hyperparathyroidism [2–4] can help us in the decision making process.

Some recent publications have analyzed through surveys the current practice of endocrinologists and endocrine surgeons in the management of pHPT patients coming from the USA [5], Europe [6], and specifically Spain [7], Switzerland [8] and Norway [9], as well as in renal hyperparathyroidism [10]. However, none of the published surveys specifically analyzes the endocrine surgeons' compliance with the recommendations of the above mentioned Consensus Conferences.

Because of this, there is a lack of information about the current surgical management of patients with pHPT in the real practice. Also, to gain further insights about how endocrine surgeons are dealing with this specific disease, more data are needed regarding the composition and type of surgical units, their surgical caseload, the pHPT surgical indications, the preoperative workup, the type of surgery performed, and the results obtained. We present herein the results of a survey carried out in two European countries. It is aimed to analyze all these details and to know the degree of adherence of endocrine surgeons to these recommendations. Furthermore, it is also aimed to identify which factors may have potential influence on the pHPT patient's surgical outcomes.

Methods

The Capítulo de Cirurgia Endócrina de la Sociedade Portuguesa de Cirurgia (CCE-SPC) and the Sección de Cirugía Endocrina de la Asociación Española de Cirujanos (SCE-AEC) sponsored this online study to determine the practice of this surgery in institutions from Portugal and Spain. In June 2014, a 35-item questionnaire (Appendix 1) was distributed to the members of both organizations, asking about organizational data of the hospital and department, surgical activity within the period 2008–2013, operative indications, preoperative workup, preferred surgical approaches, use of intraoperative adjuncts, anesthetic related aspects, type of hospitalization, and results obtained.

Those questionnaires filled in and returned before 14 January 2015 were considered valid. All data were entered into a database (Access 2007®). Qualitative data were summarized in percentages and quantitative ones by indicating the median and interquartile range (IR). The cure was defined as the attainment of postoperative normocalcemia and its maintenance for at least 6 months after surgery.

To clarify those factors that may influence on the achievement of optimal results by the different participating centers, we divided the responding institutions into two groups, placing the cut-off point among them in the median of the cure rate of all hospitals. Analysis was performed by χ^2 and Fisher's exact tests. A p value <0.05 was set for significance. SPSS v.20.0 (SPSS Ibérica, Madrid, Spain) was used for the statistical analyses.

Results

Involved institutions

Fifty-seven centers returned the questionnaire. Forty-one completed surveys (72 % of participating centers) came from

Spain and 16 from Portugal (28 %). The response rate was 32 % from the affiliated centers from SCE-AEC, and 40 % of the participants from CCE-SPC. Fifty-three hospitals were public (covering a population of 22.5 million inhabitants), three private, and with a mixed model in a last case.

In relation to the size of the hospital, seven of them were small (having fewer than 250 beds), 20 medium-sized (between 250 and 500 beds), and 30 were large centers (having more than 500 beds). In the abovementioned period, 5696 parathyroidectomies due to pHPT were performed in all centers, with an annual median of 14 per center (IR 8.5–23). Only 23 % of the centers (12 % in Portugal, 27 % in Spain) performed more than 25 surgeries per year.

Forty-six institutions (81 %) reported to have endocrine surgery units (ESU): 69 % in Portugal and 85 % in Spain. In 81 % of the centers, regularly scheduled endocrine pathology multidisciplinary meetings took place. These meetings were more frequently performed in those hospitals with ESU (93 vs. 27 %). The median of the surgeons who carried out parathyroid surgery was 3 (IR 2–3), with a median of 6 per surgeon/year procedures (IR 3.4–9.3).

Surgical indications

The criteria derived from the Third International Workshop on the management of asymptomatic primary hyperparathyroidism [4] were used by 94 % of the surveyed centers. However, 51 % of institutions considered other surgical indications for asymptomatic pHPT, not covered in this guideline. They included patient preferences (15.8 % of all units), patients older than 50 (12.2 %), in cases of difficult follow-up (10.5 %), the existence of nephrolithiasis (8.7 %), vague symptoms like weakness, fatigue, depression, and anxiety, decreased memory and concentration, irritability, and disturbed sleep (8.7 %), a corrected serum calcium above 11 mgr/dL (5.2 %) and in cases with simultaneous thyroidectomy (5.2 %). Those situations discouraging pHPT surgical treatment are shown in Table 1, both overall and disaggregated by country.

Table 1 Situations that discourage the surgical indication

Situations discouraging surgical indication*	Overall (%)	Portugal (%)	Spain (%)
High surgical risk	47	75	36
Not feasibility of general anesthesia	42	44	41
Persistent non-localized pHPT	40	47	37
Normocalcemic pHPT	30	37	27
Image-negative pHPT	11	19	7
Persistent localized pHPT	5	7	5
Asymptomatic pHPT	4	6	2

pHPT primary hyperparathyroidism

*By decreasing frequency order

Preoperative workup

All surgical units systematically order serum calcium and iPTH levels. Regarding 25-OH vitamin D, urinary calcium levels, and Ca/ creatinine clearance ratio, the percentages of institutions ordering for dropped at 66, 58, and 30 %, respectively. Although no unit was practiced as a routine, 81 and 38 % of surveyed surgeons considered in some cases genetic tests and selective venous sampling (SVS), respectively.

Regarding the evaluation of target organs of the disease, only 46 % requested routine bone densitometry and 25 % renal ultrasound. Concerning image techniques, the most frequent routinely ordered test was (99 m) Tc-MIBI scintigraphy (91 % of units), followed by ultrasonography (US) of the neck (88 %). Computed tomography (CT) was ordered on routine basis only in 2 % of units. In 18 % of the hospitals, fusion techniques as single-photon emission computed tomography (SPECT-CT) complemented all MIBI scintigraphies.

According to the opinion of 77 % of the surveyed surgeons, the most reliable imaging technique was MIBI scintigraphy. Otherwise, 16 % of them considered neck ultrasound a more reliable technique, and 7 % relied equally in both. In 95 % of the centers, radiologists performed cervical ultrasound, in 20 %, endocrinologists performed US as well, and in 10 %, surgeons are those who usually perform this technique.

Facing a negative ultrasound and MIBI scan, the attitude of surgeons varied depending on whether it was primary surgery or reoperation. In the first scenario, 56 % of surgeons proposed surgery through bilateral neck exploration, while 44 % would request additional imaging techniques. Otherwise, only 16 % of surgeons would go straight to the surgery by bilateral approach, and 84 % require additional tests when facing reoperations. Most ordered imaging techniques for this clinical setting were magnetic resonance imaging (MRI) (59 %), and CT scan (52 %), followed by SPECT-CT and positron emission tomography (PET) scan. A fifth of the surveyed surgeons would have ordered a SVS facing a reoperation with negative ultrasound and MIBI scan.

Surgical approaches

The indications for selective parathyroidectomy considered by the respondents are listed in Table 2. A selective

Table 2 Indications for selective parathyroidectomy

Most common situations that indicates selective parathyroidectomy*	Overall centers (%)	Portuguese centers (%)	Spanish centers (%)
Concordant ultrasound and MIBI scan results, uniglandular disease suspected	89	80	93
Uniglandular disease suspected by one test. Other test negative	55	47	59
Suspicion of double adenoma (both at the same side)	14	40	7
Never	5	13	2
Routinely	5	7	5

*By decreasing frequency order

parathyroidectomy was a feasible technique in case of persistent or recurrent pHPT for 49 % of surgeons, while for 51 %, a bilateral neck exploration would be the preferred approach regardless of the preoperative imaging findings. Among surgeons performing selective approaches, 91 % carried out open minimally invasive parathyroidectomy (OMIP), 13 % minimally invasive video-assisted parathyroidectomies (MIVAP), and 2 % endoscopic parathyroidectomies via a lateral approach. The median percentage of focused approaches on the total of parathyroidectomies performed was 58 % (IR 25–83).

Intraoperative adjuncts

Intraoperative iPTH measurements were used by 92 % of departments. In 88 % of institutions, this technique was performed even when preoperative localization techniques were concordant for single-gland disease. Regarding the biochemical cure criteria, Miami criteria [11] were the most used (68 % of centers), followed by Vienna [12] (28 %), and Rome criteria [13], used by 4 % of departments.

Regarding the surveyed nations, 50 % of Portuguese surgeons preferred Vienna criteria, comparing to 19 % of Spanish surgeons. Facing a lack of decline in iPTH levels under requested values at 10 min post resection, 68 % of centers proposed to obtain a new sample before converting to bilateral neck exploration. The delay in obtaining results of intraoperative PTH measurement had a median of 30 min (IR 20–40) in the participating centers. Three out of five surgeons recognized that not all patients were kept anesthetized until the reception of results.

Use of routine frozen section was supported by 42 % of departments. Radio-guided surgery, intraoperative neuromonitoring, and methylene blue injection were selectively used in 34, 29, and 9 % of centers, respectively. The use of other intraoperative adjuncts (venous sampling, PTH measurement on aspirated samples, or scintigraphy) was anecdotally reported.

Types of anesthesia and hospital admission

Concerning the anesthesia modalities available, in addition to general anesthesia, in 12 and 4 % of hospitals, pHPT surgery could also be performed under local and regional anesthesia, respectively. In relation to the types of admission scheduled, in 81 % of institutions (56 % in Portugal, 90 % in Spain) parathyroid surgery was performed as day surgery, and in 23 % of centers (27 % in Spain, 13 % in Portugal), it was also carried out on ambulatory basis (discharge 4–8 h after surgery).

Results of surgery. Analysis of factors that impact on cure rate

The duration of postoperative follow-up varied widely among participating centers, with a median of 6 months (IR 1–12). We received outcomes data from 54 centers. During the surveyed period, a total of 5507 patients underwent parathyroidectomy for pHPT in these institutions. Among them, 196 (3.5 %) were not cured with surgery. A cure rate above 95 % was achieved in 41 of the 54 institutions (76 %), and the median for all departments was 97 % (IR 95–98). Factors with potential impact on cure rate and the results of the analysis are shown in Table 3.

Discussion

Key results

In this study, we found that parathyroid surgery is carried out in institutions with a wide range of complexity, generally within specialized surgical units, with a scarce number of

Table 3 Factors with possible impact on cure rate

Factor	Groups for analysis	Percentage of centers that meet the criteria*	*p*
Country	Spain	70.0	0.206†
	Portugal	50.0	
Institution size	Small (<250 beds)	42.8	0.097‡
	Medium (250–500 beds)	83.3	
	Big (>500 beds)	58.6	
Institution volume	Small (<12 parathyroidectomies/year)	70.0	0.720‡
	Medium (12–25 parathyroidectomies/year)	57.1	
	Large (>25 parathyroidectomies/year)	66.6	
Presence of Endocrine Surgery Unit at the Institution	Yes	72.1	**0.038**†
	No	36.3	
Scheduled multidisciplinary meetings on endocrine diseases	Yes	70.4	0.139†
	No	40.0	
Is it a surgical contraindication for first-time surgery the negative results in imaging techniques?	Yes	63.2	0.646†
	No	80.0	
More reliable imaging technique	MIBI scan	57.1	0.134†
	Neck ultrasound	87.5	
Attitude before first surgery facing patients with negative results of MIBI scan and ultrasound	Perform bilateral neck exploration	70.9	0.388‡
	Order new imaging techniques	56.5	
Is it a reasonable option a selective parathyroidectomy in patients with persistent or recurrent pHPT?	Yes	72.0	0.562‡
	No	62.9	
Use of intraoperative parathormone measurement	Systematic	66.6	0.863‡
	Selective	57.1	
	Never	60.0	
Used biochemical cure criteria	Miami	69.7	0.503‡
	Vienna	53.3	
	Rome	50.0	

MIBI methoxyisobutylisonitrile, *pHPT* primary hyperparathyroidism

[a] With a cure rate equal to or greater than the median (97 %) of all surgical centers

† Fisher's exact test; ‡ Chi-square test

procedures performed yearly by institution and surgeon. Regarding indications, the majority of departments followed the recommendations from the Third and Fourth International Workshop on the management of asymptomatic primary hyperparathyroidism, although more than half of the respondents recognize accepting other indications not covered by the guidelines. The preoperative study (except for the scarcely assessed target organs of the disease) and the surgical approach performed adhere quite well with the recommendations from the ESES positional statement, emphasizing the limited use of video-assisted approaches. Intraoperative PTHi determination is widely used, being Miami the preferred criteria for cure by the Iberian surgeons. The cure rate after surgical treatment of pHPT was very adequate in most institutions, and the existence of specialized endocrine surgery units positively influence on it.

Interpretation of results

Only a quarter of all participant centers performed an average of more than 25 procedures per year. This condition was among the requirements for institutions to be considered as a referral center in the "Certification system for thyroid and parathyroid surgery Units" of the German Society of General and Digestive Surgery [14]. This requirement has been established as a suitable grouping criterion by the Iberpara group. The finding of a median of 14 procedures per year in our study compares favorably with the 12 procedures found at the Spanish endocrinologists survey [7], although is slightly lower than the 18 annual cases documented in the Norwegian study [9], and well below the average of 33 cases from the US study [5]. This data can be explained either by some degree of underdiagnosis of this entity, by the absence of a real policy

for referring patients to reference surgical centers in our countries, or by a lower rate of surgical indication by the endocrinologist. In the survey of Spanish endocrinologists [7], approximately 60 % of newly diagnosed patients were referred for parathyroidectomy. In the European survey, similar figures for symptomatic pHPT were obtained from Germany (74 %), UK (72 %), France (64 %), and lower for Italy (42 %) [6].

In our survey, 20 % of participating institutions do not have a formal well-established endocrine surgery unit, and as far we are concerned, there is not published data regarding the effect of the presence of an endocrine surgical unit on the rate of cure in pHPT. In our study, we found that the presence of these units was the only factor with positive impact on the results. Nevertheless, probably the definition of endocrine surgery unit should be addressed since the limited number of procedures performed yearly by surgeon does not fit properly with the idea of a devoted surgical unit.

Surgical indications for asymptomatic pHPT comply quite well with the guidelines derived from the Third Workshop on management of asymptomatic primary hyperparathyroidism [4]. However, more than half of the surveyed surgeons included other situations, showing a trend towards a more comprehensive surgical treatment of asymptomatic pHPT. Furthermore, we have shown that the surgical indication owing to the presence of nephrolithiasis or nephrocalcinosis have been already incorporated even before that the Fourth Workshop on management of asymptomatic primary hyperparathyroidism elicited guidelines were published [2, 3].

Regarding those situations discouraging the surgical indication of pHPT, in 11 % of institutions, surgery is still contraindicated in patients with negative localization testing, despite the published recommendations [1, 2, 4]. This percentage is a little bit lower than the 15 % obtained at the survey of Spanish endocrinologists [7]. The proportion of institutions that considered a surgical contraindication the asymptomatic pHPT was low (4 %), while 30 % of surgeons did not consider normocalcemic pHPT as a surgical indication. Because of the fact that we do not find data on surgery referral policies in normocalcemic pHPT, we are not able to read into such figures. Although many physicians use to approach to normocalcemic pHPT in a similar manner to asymptomatic pHPT, evidence-based guidelines on this issue are lacking [15].

The preoperative workup employed by the participating units was generally consistent with the current international recommendations. However, facing negative or non-concordant results of neck ultrasound and MIBI scan, 44 % of surgeons ordered additional tests before first-time surgery. In this clinical scenario, the ESES positional statement recommends a bilateral neck exploration without further imaging. Then, in this situation, nearly half of the surveyed surgeons were prone to ensure preoperative localization to enhance the possibility for the selective surgical approach. It is noteworthy that very few of the interviewed surgeons are aware of tests for the disease's target organs, as only 46 % of the departments requested a routine bone densitometry, and 25 % a renal ultrasound. The guideline of the IV Workshop on management of asymptomatic pHPT is expected to improve this figure, by including the presence of nephrolithiasis or nephrocalcinosis as an indication of parathyroidectomy in asymptomatic pHPT [3].

The indication of selective and minimally invasive parathyroidectomy collected in this survey was in accordance with the current recommendations in cases of first-time surgery. However, for persistent or recurrent pHPT, 51 % of participating institutions do not share the criteria from the ESES positional statement which considers that whenever possible, a selective image-guided approach is preferred. It is possible that these responses correspond to centers with low-activity volume and less experience, although we could not detect worse results in practice from low-volume departments.

It is remarkable how small was the number of centers that have incorporated the techniques of assisted endoscopic resection. Techniques like the endoscopic parathyroidectomy [16], MIVAP technique [17], and endoscopic parathyroidectomy via a lateral approach [18] are only implemented in 15 % of institutions, more than 10 years after its description. Some factors can justify this fact, among them, the lack of training centers and patient centralization policies, the need to overcome a learning curve, and probably some pressures to improve the efficiency of surgical sessions, along with the few perceived advantages with respect to OMIP approach.

Related to intraoperative adjuncts, the intraoperative parathormone measurement was widely implemented, being performed in 92 % of centers. However, the cost-effectiveness of its current use has been controversial: it was performed in 88 % of centers when preoperative localization techniques were concordant for single-gland disease. In that situation, the positional statement of ESES considers it of little added value [1]. Moreover, more than half of the participant surgeons recognize that in their centers, not all patients scheduled for intraoperative PTH measurement are kept anesthetized until the results are received. This could be due to both the pressure to optimize the operating room time and perhaps a merely academic interest in many participating centers regarding this technique.

In connection with the analysis of factors that may have influenced the results, we found no differences depending on the country. Data seems to show minimal differences between the two nations in terms of volume of procedures, situations that discourage the surgical indication, indications for selective parathyroidectomy, and

hospitalization types, but these have no impact on the outcomes regarding the achieved cure rate. Moreover, we have not found differences in outcomes related to the size of the institution or its volume of parathyroid surgery, or whether they had multidisciplinary endocrine pathology meetings. The opinions of surveyed surgeons on the attitude when facing negative imaging techniques, the preferred image exploration, or whether they believe that selective approach is appropriate for a persistent pHPT, have no impact on the outcomes.

In our study, the percentage of curative interventions was 96.5 %. This percentage is somewhat higher than the previous Spanish reported rate of 90 % [7], and similar to the other series, ranging between 95 and 98 % at first surgery [12]. Our findings underscore the importance of training experienced surgical teams for improving results. Furthermore, the impact of the availability of a minimally invasive surgical procedure on the number of patients referred for surgery seems to be considerable. In the Swiss survey, 61 % of the endocrinologists would expand the indication for surgery if the operation could be done by a limited surgical approach [8].

Limitations and generalizability of the results

Although hospitals were encouraged to assess clinical databases for reporting data, differences in quality of databases could have influenced the results. On the other hand, the low participation rate obtained, a limit of the study, can be related to the comprehensiveness of the information requested, which could have imposed a selection bias, since respondents may not represent all Spain and Portuguese surgeons. Other reason related to low participation rate could be the fact of being an unpaid study. Unlike the European and Spanish endocrinologists studies [6, 7], we decided not to seek the support of industry to encourage participation, avoiding a potential source of conflicts of interest.

There may be also a selection bias since we do not know the percentage of not surgically treated cases in the same period. It is possible that high-volume and experienced institutions were less selective in accepting cases. In less experienced departments, the results of the operated patients could have been improved by excluding a substantial percentage of patients with vague symptoms and negative localization tests, with lower cure rates.

Despite all previous limitations, the absence of current data in our two countries about pHPT surgical management makes our results of relevance. Our study is the largest multicenter and multinational European survey ever reported on surgical management on pHPT and the first attempt to know how endocrine surgeons comply with current recommendations on surgery for primary hyperparathyroidism.

Conclusion

The surgical treatment of pHPT is practiced in Portugal and Spain in institutions of different complexity, usually within specialized endocrine surgery units. The number of annual procedures is relatively low in most of them. The surgical indications and the preoperative workup generally comply with the current international recommendations, except for a scarce study of the target organs of the disease.

The indication of selective and minimally invasive parathyroidectomy was also adapted to current recommendations, even though to a lesser extent in persistent pHPT. Most units have not implemented the endoscopically-assisted resection techniques.

Intraoperative PTH determination is widely implemented, although the cost-effectiveness of its current use is debatable. The rest of intraoperative adjuncts are rarely used, as well as the locoregional anesthesia. There is a positive impact on the results of this surgery by its performance within specialized surgical units.

Acknowledgments The Endocrine Surgery Divisions of the National Surgical Societies from Spain and Portugal wish to thank to all the Iberpara participating investigators:

Miguel Allen, Cristina Álvarez Segurado, Alexandre Alves, Teresa Alves Conceiçao, Borja Barrios Treviño, Adolfo Basáñez Amuchástegui, Elisabeth Bollo Arocena, José Miguel Bravo de Lifante, Marifé Candel Arenas, João Capela Costa, Ana Carrión Tomás, Daniel Casanova Rituerto, Olimpia Cid, Pablo Colsa Gutiérrez, José Mario Coutinho, Carlos Cruz, Aitor de la Quintana Basarrate, Leonardo De Tursi Rispoli, Joan Doménech Calvet, Manuel Durán Poveda, Rosário Eusébio, Benito Flores Pastor, Francisco García Lorenzo, Joaquín Gómez Ramírez, Carmen González Sánchez, Xavier Guirao Garriga, Antonio Jiménez García, Javier Jiménez Olmo, Pedro Koch, Itziar Larrañaga Blanc, Jesús Martín Fernández, Rosario Martínez García, José Ignacio Martínez Pueyo, Cristina Martínez Santos, Juan Manuel Martos Martínez, Armando Medeiros, Enrique Mercader Cidoncha, Antonio Moral Duarte A, Pablo Moreno Llorente, José Manuel Nuño Vázquez-Garza, Ana Oliveira, Joaquín Ortega Serrano, José Polónia, Antónia Póvoa, José Antonio Puñal Rodríguez, Ana Rafael, José Rocha, Susana Ros López, Jorge Rosa Santos, Pilar Salvador Egea, Antonio Sitges-Serra, Teixeira Gomes, Pedro Trillo Parejo, Óscar Vidal Pérez, Jesús Villar del Moral, Pedro José Yunta Abarca.

The authors also appreciate the translation assistance from Rosa María Vidal Quintana.

Compliance with ethical standards

Conflicts of interest The authors declare that they have no competing interests.

Appendix 1: Text of the survey

INSTITUTION DETAILS AND VOLUME OF ACTIVITY

Name of Institution:
City: Country:
Type of Hospital: Private Public:
Number of Beds: <250 250-500 >500
Is there a specific Unit for Endocrine Surgery?
Yes No
Are Multidisciplinary Endocrine Pathology sessions periodically hold? Yes No
Number of parathyroidectomies due to pHPT performed in:
2008: 2009: 2010: 2011: 2012: 2013:
Number of parathyroid surgeons in the center:

Population attended at the hospital in thousands of inhabitants:

SURGICAL INDICATIONS:

In asymptomatic pHPT, do you use the surgical indications derived from the Third International Workshop for primary Hyperparathyroidism published in 2009 ?

Do you consider that there could be surgical indications outside these criteria in asymptomatic pHPT?
Yes No Indicate in which situations:

Facing a pHPT, which situations in your unit poses a surgical contraindication? (More than one can be selected):

1. Surgical high risk.
2. General anesthesia impossibility.
3. Negative preoperative localization tests.
4. Normocalcemic pHPT.
5. Persistent or recurrent pHPT with negative localization testing.
6. Persistent or recurrent pHPT with positive localization testing.

PREOPERATIVE WORKUP:

How frequently do you order the following tests?

	ALWAYS	IN MOST CASES	IN SOME CASES	NEVER
Calcemia				
Calciuria				
calcium/ urinary creatinine rate				
PTH				
25-OH Vitamin D				
Genetic tests				
Bone densitometry				
Renal ultrasound				
Neck ultrasound				
MIBI scintigraphy				
SPECT-CT				
CT				
MRI				
PET				
FNA with PTH measurement in the sample				
Selective venous sampling				

Which localization techniques do you consider to be more reliable in you center?
Untrasound Sestamibi scan

Who performs the ultrasounds in your center?

1. Radiologist.
2. Surgeon.
3. Endocrinologist.

What has to be done if the ultrasound and MIBI scintigraphy are negative on a patient diagnosed with pHPT who has not been operated before?

1. Bilateral neck exploration
2. Additional localization testing

In case of selecting additional localization testing, note which test:

And facing negative ultrasound and sestamibi scan, on a patient with persistent or recurrent pHPT?

1. Bilateral neck exploration
2. Additional imaging test

In case of selecting additional imaging tests, note which test:

SURGICAL TREATMENT:

Surgical approaches:

In your Department, when can be scheduled a selective or minimally invasive parathyroidectomy? (several answers can be selected):

1. Always.
2. In case of positive and concordant ultrasound and scintigraphy, suggesting uniglandular disease.
3. In case of one test positive (suggesting uniglandular disease), and other test negative.
4. Facing suspicion of a double unilateral adenoma on preoperative imaging.
5. In case of negative imaging tests.
6. Never.

Would a selective parathyroidectomy be feasible in cases of persistent or recurrent PHPT? Yes No

Types of minimally-invasive approaches used:

1. OMIP (*open minimally-invasive parathyroidectomy*).
2. EP (*endoscopic parathyroidectomy*).
3. MIVAP (*minimally-invasive videoassisted parathyroidectomy*).

Percentage of patients subjected to selective parathyroidectomy in 2008-2013 in your Department:

Use of adjuvants to surgery techniques:

Is the intraoperative PTH measurement performed in your Institution?

Always Selectively No.

Do you perform it in case of positive and concordant ultrasound and scintigraphy, with suggestion of uniglandular disease ? Yes No

Which biochemical cure criteria is used in your Center?

1. Miami Criteria
2. Vienna Criteria.
3. Halle Criteria.
4. Rome Criteria.

Is the patient kept anesthetized while you are waiting for the results of intraoperatory PTH measurement?

1. Always
2. In most cases
3. In some cases
4. Never

What do you do when the PTH drop does not meet the biochemical cure criteria?

1. Perform a bilateral neck exploration.
2. Getting a new blood sample for PTH measurement. If it is still no proper descent in it, performing a bilateral neck exploration.
3. Getting a new blood sample for PTH determination, and finishing surgery. If it is still no proper descent in it, the case is reevaluated and a new surgery is occasionally planned.

Use of other intraoperative adjuncts:

	ALWAYS	IN MOST CASES	IN SOME CASES	NEVER
Frozen section				
Intravenous methylene blue injection				
Intraoperative neuromonitorization				
Radio-surgery				
Intraoperative selective venous sampling				
Determination of intraoperative PTH in FNA aspirate				

Type of anesthesia used (several options can be selected):

1. General.
2. Regional.
3. Local

Type of hospitalization (several options can be selected):

1. Major ambulatory surgery.
2. Day surgery (24-hour hospitalization).
3. Hospitalization scheduled for more than 24 hours.

RESULTS:

Length of habitual postoperative follow-up:

Percentage of succesfull parathyroidectomies in 2008-2013:

Percentage of patients with persistent pHPT in 2008-2013:

How many of them have been reoperated?

Percentage of patients with recurrent pHPT in 2008-2013:

How many of them have been reoperated?

References

1. Bergenfelz A, Hellman P, Harrison B, Sitges-Serra A, Dralle H (2009) Positional statement of the European Society of Endocrine Surgeons (ESES) on modern techniques in pHPT surgery. Langenbeck's Arch Surg 394:761–764. doi:10.1007/s00423-009-0533-5
2. Udelsman R, Åkerström G, Biagini C, Duh QY, Miccoli P, Niederle B, Tonelli F (2014) The surgical management of asymptomatic primary hyperparathyroidism: proceedings of the Fourth International Workshop. J Clin Endocrinol Metab 99:3595–3606. doi:10.1210/jc.2014-2000
3. Bilezikian JP, Brandi ML, Eastell R, Silverberg SJ, Udelsman R, Marcocci C, Potts JT Jr (2014) Guidelines for the management of asymptomatic primary hyperparathyroidism: summary statement from the Fourth International Workshop. J Clin Endocrinol Metab 99:3561–3569. doi:10.1210/jc.2014-1413
4. Bilezikian JP, Khan AA, Potts JT Jr (2009) Guidelines for the management of asymptomatic primary hyperparathyroidism: summary statement from the Third International Workshop. J Clin Endocrinol Metab 94:335–339. doi:10.1210/jc.2008-1763
5. Muñoz Torres M, Jodar Gimeno E, Reyes Garcia R, Martínez Diaz Guerra G, Amado JA, Gaztambide S, Quesada Gómez JM, Calcium Study Group (2012) Results from a national survey on the management of primary hyperparathyroidism. J Endocrinol Investig 35:957–963. doi:10.3275/8184
6. Langdahl BL, Ralston SH (2012) Diagnosis and management of primary hyperparathyroidism in Europe. Q J Med 105:519–525. doi:10.1093/qjmed/hcr225
7. Clerici T, Warschkow R, Triponez F, Brändle M (2007) National survey on the management of primary hyperparathyroidism by Swiss endocrinologists. Langenbeck's Arch Surg 392:611–615
8. Lindekleiv HM, Due J, Svartberg J, Varhaug JE (2009) Treatment practice in primary hyperparathyroidism. Tidsskr Nor Laegeforen 129:300–302. doi:10.4045/tidsskr.09.34210
9. Sosa JA, Powe NR, Levine MA, Udelsman R, Zeiger MA (1998) Profile of a clinical practice: thresholds for surgery and surgical outcomes for patients with primary hyperparathyroidism: a national survey of endocrine surgeons. J Clin Endocrinol Metab 83:2658–2665
10. Carneiro DM, Solorzano CC, Nader MC, Ramirez M, Irvin GL III (2003) Comparison of intraoperative iPTH assay (QPTH) criteria in guiding parathyroidectomy: which criterion is the most accurate? Surgery 134:973–979
11. Riss P, Kaczirek K, Heinz G, Biglmayer C, Niederle B (2007) A "defined baseline" in PTH monitoring increases surgical success in patients with multiple gland disease. Surgery 142:398–404
12. Lombardi CP, Rafaelli M, Traini E, Di Stasio E, Carrozza C, De Crea C, Zuppi C, Bellantone R (2008) Intraoperative PTH monitoring during parathyroidectomy: the need for stricter criteria to detect multiglandular disease. Langenbeck's Arch Surg 393:639–645. doi:10.1007/s00423-008-0384-5
13. Riss P, Asari R, Scheuba C, Niederle B (2013) Current trends in surgery for renal hyperparathyroidism (RHPT)—an international survey. Langenbeck's Arch Surg 398:121–130. doi:10.1007/s00423-012-1025-6
14. Deusche gesellschaft für allgemein und visceralchirurgie. Certification system for thyroid and parathyroid surgery Units. German Society of General and Digestive Surgery. Available from: http://www.dgav.de/english/certification/surgical-endocrinology.html Accessed 8 June 2015
15. Silverberg SJ, Clarke BL, Peacock M et al (2014) Current issues in the presentation of asymptomatic primary hyperparathyroidism: proceedings of the Fourth International Workshop. J Clin Endocrinol Metab 99:3580–3594. doi:10.1210/jc.2014-1415
16. Gagner M (1996) Endoscopic subtotal parathyroidectomy in patients with primary hyperparathyroidism. Br J Surg 83:875
17. Miccoli P, Bendinelli C, Conte M, Pinchera A, Marcocci C (1998) Endoscopic parathyroidectomy by a gasless approach. J Laparoendosc Adv Surg Tech A 8:189–194
18. Henry JF, Defechereux T, Gramatica L, De Boissezon C (1999) Endoscopic parathyroidectomy via a lateral neck incision. Ann Chir 53:302–306