World J. Surg. 28, 1219–1223, 2004
DOI: 10.1007/s00268-004-7601-3

WORLD
Journal of
SURGERY

Endoscopic Parathyroid Surgery: Results of 365 Consecutive Procedures

Jean-François Henry, M.D., Frédéric Sebag, M.D., Paola Tamagnini, M.D., Céline Forman, M.D., Horatiu Silaghi, M.D.

Department of Endocrine Surgery, University Hospital La Timone, 264 Rue Saint Pierre, Cedex 05 13385 Marseilles, France

Published Online: November 4, 2004

Abstract. In recent years, several series have documented the feasibility of endoscopic approaches for parathyroid diseases. We performed a retrospective study to evaluate the results of endoscopic parathyroidectomy (EP) in the management of our patients with primary hyperparathyroidism (PHPT). During a 5.5 year period (1998–2003), we operated on 644 patients with PHPT. EP was proposed for patients with sporadic PHPT, without associated goiter, and without previous neck surgery in whom a single adenoma was localized by means of sonography and sestamibi scanning. EP was performed by the lateral approach with insufflation for patients with an adenoma located deep in the neck and by a gasless midline approach for patients whose adenoma was located anteriorly. A quick parathyroid (QPTH) assay was used during the surgical procedures. Among 644 patients with PHPT, 279 (43.3%) were not eligible for EP for the following reasons: associated nodular goiter (116 cases), previous neck surgery (52 cases), suspicion of multiglandular disease (31 cases), lack of preoperative localization (61 cases), and miscellaneous causes (19 cases). EP was performed in 365 patients with sporadic PHPT: 339 lateral access, 25 midline access, and one thoracoscopy. The median operating time was 49 minutes (16–130 minutes). Conversion to conventional parathyroidectomy was required in 49 patients (13.4%) for these reasons: missed adenomas (14 cases), difficulty with the dissection (8 cases), multiglandular disease correctly predicted by QPTH (11 cases), false-negative QPTH assay results (4 cases), false-positive sestamibi scan results (11 cases), and 1 false-positive sonography result. One patient presented with definitive recurrent nerve palsy. Three patients remained hypercalcemic, and one other patient had recurrent hypercalcemia. In conclusion, EP can be proposed for more than half of the patients with PHPT. Immediate results of EP are similar to those obtained with conventional parathyroidectomy, but no conclusions can be drawn in terms of the influence of EP on the outcome of the patients operated on for PHPT.

For many years bilateral cervical exploration remained the preferred surgical approach in patients with primary hyperparathyroidism (PHPT). Today the conventional approach is challenged by new, less invasive procedures: the extent of exploration can be unilateral [1–3] or focused on one gland through mini-open incisions [4–6]. These new explorations can be radio-guided [7, 8], video-assisted, or fully endoscopic [9–19].

Endoscopic techniques are particularly suitable for parathyroid surgery for several reasons. First, they are ablative procedures, and do not require elaborate surgical reconstruction. Second, most parathyroid tumors are small and benign. Finally, reducing the length of the scar to about 10 to 12 mm is appealing to many patients.

Since the first endoscopic parathyroidectomy reported by Gagner in 1996 [9] several other techniques have been described. Some of them, such as the minimally invasive video-assisted parathyroidectomy (MIVAP) proposed by Miccoli et al. [20], do not require the use of endoscopy during the entire operation. Other, less common techniques do not use the neck approach but do use the axillary [18] or anterior chest [17] approach.

In 1998 we developed a technique for endoscopic parathyroidectomy using a lateral neck approach along the line of the anterior border of the sternocleidomastoid (SCM) muscle [21]. In this retrospective study, we evaluated the results of endoscopic parathyroidectomy using the lateral approach (EPLA) in the management of our patients with PHPT.

Materials and Methods

During a 5.5 year period (1998–2003) we operated on 644 patients with PHPT in the department of endocrine surgery at University Hospital La Timone in Marseilles. An endoscopic approach was proposed for patients with sporadic PHPT in whom a single adenoma was localized by means of sonography and sestamibi scanning but who did not have an associated goiter or previous neck surgery. EPLA was performed in patients with an adenoma located deep in the neck [21]. A 12 mm transverse skin incision as made on the anterior border of the SCM, and a back-door approach was used to reach the retrothyroid space. Three trocars (one 10 mm and two 2–3 mm) were inserted along the line of the anterior border of the SCM. The working space was maintained with low CO_2 pressure at 8 mmHg. During this unilateral exploration, one could identify both the adenoma and the ipsilateral parathyroid gland. Small adenomas were directly extracted through the 10 mm trocar; large adenomas that could not be introduced into the 10 mm trocar were extracted through the trocar site.

A gasless midline approach was performed in patients with adenomas located anteriorly. A 15 mm skin incision was made at the suprasternal notch. The procedure was carried out between the strap muscles with the assistance of a 5 mm endoscope (0 or 30

This article was presented at the International Association of Endocrine Surgeons meeting, Uppsala, Sweden, June 14–17, 2004.

Correspondence to: Jean-François Henry, M.D., e-mail: jfhenry@ap-hm.fr

Table 1. Contraindications for endoscopic parathyroidectomy in 279 of the 644 patients who underwent surgery for PHPT.

Contraindication	No. of patients
Associated nodular goiter	116
Inconclusive preoperative localization	61
Previous cervical surgery	52
Suspicion of multiglandular disease	31
Acute hyperparathyroidism	5
Large tumor	6
Local anesthesia	3
Major ectopia	4
Cervical hematoma	1

PHPT: primary hyperparathyroidism.

Table 2. Reasons for conversion to conventional cervicotomy in 49 of 365 patients who underwent endoscopic parathyroidectomy.

Reason for conversion	No. of patients
Adenomas not found	14
Difficult dissections	8
QPTH assay: true-negative result	11[a]
QPTH assay: false-negative result	4
Sestamibi scan: false-positive result	11
Ultrasonography: false-positive result	1

QPTH: quick parathyroid hormone.
[a]Eleven patients had multiglandular disease.

degrees). All maneuvers were therefore performed openly without gas insufflation. All instruments were introduced through the midline incision. There was no need for additional trocars. Because of their anterior location, dissection of these glands remained anterior to the trachea and did not require previous identification of the recurrent laryngeal nerve, which runs more posteriorly. Parathyroid glands located deep in the thymus could also be removed endoscopically using this midline access.

The QPTH assay (Nichols Institute Diagnostics, San Juan Capistrano, CA, USA) was used during the surgical procedures. Calcemia, phosphoremia, and the parathormone (PTH) level were systematically evaluated in patients on 1 and 8 days, 1 month, and 1 year after surgery. All patients underwent preoperative and postoperative investigations of vocal cord movements.

Results

Of the 644 patients with PHPT, 279 (43.3%) underwent a conventional open approach and 365 (56.7%) the endoscopic technique. Patients who underwent an open approach had displayed some contraindication(s) for the endoscopic approach: a large multinodular goiter that required an associated thyroidectomy in 116 cases, inconclusive localizing studies in 61 cases, previous cervical surgery in 52 cases, suspicion of multiglandular disease in 31 cases, and other reasons in 19 cases (Table 1).

Endoscopic parathyroidectomy was performed in 365 patients with sporadic PHPT: using the lateral approach in 339 cases with a median operating time of 50 minutes (range 25–130 minutes), which has been lowered to 42 minutes in the last 150 cases, or by a central approach in 25 cases with a mean operating time of 35 minutes (range 16–60 minutes). One patient was operated on by thoracoscopy for an adenoma located extremely low in the anterior mediastinum. Of the 25 patients in whom a central approach was used, 2 had an associated unilateral thyroid lobectomy. There were 282 women and 83 men with a mean age of 59.2 years (range 20–89 years). Recurrent laryngeal nerves were identified in 95.6% of cases. There were 352 solitary lesions: 347 adenomas with a mean weight of 1140 mg (range 100–7080 mg) and 5 carcinomas requiring two conversions and three secondary open reoperations to perform an en bloc excision of the parathyroid tumor, thyroid lobe, ipsilateral parathyroid, and adjacent lymph nodes. Thirteen patients had multiglandular disease (five had double adenomas, and eight had hyperplasia).

Conversion to open conventional surgery was required in 49 patients (13.4%), all of whom underwent an EPLA (Table 2). Causes for conversion included a missed adenoma after a 2-hour search (14 patients: mean weight 701 mg, range 320–2100 mg); difficulty with dissection or a large adenoma taking up most of the working space (8 cases); false-positive imaging studies (12 cases); and inadequate decrease in the QPTH assay results (15 cases). During conversion, 11 of those 15 patients presented with multiglandular disease. In the other four patients, three other glands were found and were normal. Up to now these four patients appear cured. Therefore, in our series we observed 11 true-negative and 4 false-negative QPTH assay results (Table 3).

Postoperative morbidity included permanent recurrent laryngeal nerve damage in one patient, two hematomas in the SCM muscle, one wound of the internal jugular vein, and six capsular tears. These capsular disruptions occurred during dissection of large, fragile adenomas weighing on average 4366 mg. Five patients who underwent conversion presented with transitory hypocalcemia. There was no mortality, and most patients were discharged from the hospital the next day without morbidity. Three patients were left with hypercalcemia and suspicion of persistent PHPT; one of them was reoperated 1 year later and presented with multiglandular disease. The median follow-up for 244 patients reviewed was 16.9 months (range 2–63 months). Another patient had had a 600 mg adenoma removed and for 15 months had normal serum calcium levels; now he is suspected to have recurrent PHPT.

Discussion

In our opinion, compared with other minimally invasive procedures performed nonendoscopically, endoscopic techniques are safer. The endoscope provides a larger, better surgical image, with magnification of all anatomic structures. By direct vision through mini-incisions, it is probably more difficult to obtain an adequate view of structures, and it is our belief that optimal conditions for exploration are not met even if surgeons use frontal lamps and surgical loupes.

Carbon dioxide insufflation may cause hypercarbia, respiratory acidosis, and subcutaneous emphysema. Nevertheless, insufflation is harmless so long as the procedure is performed under low pressure.

In experienced hands, endoscopic parathyroid techniques are as safe as the standard open procedure, and there is no mortality. The incidence of recurrent nerve palsy is low: less than 1%. Once again, we think that use of the endoscope allows the surgeon to perform a dissection as safely as with open surgery. The rate of transient hypocalcemia is reduced to between 2.5% and 3.2% [15, 22]. Similar

Table 3. Quick PTH assay results for 363 patients.

Result	Patients (no.)
True positive	346 (95.3%)
False positive	2 (0.6%)
True negative	11 (3.0%)
False negative	4 (1.1%)

findings have been reported with other minimally invasive techniques [23], which may be the result of a less extensive dissection and targeted removal of the adenoma.

Endoscopic procedures can be achieved in less than 1 hour, and the operating time improves dramatically after the first few procedures are accomplished. The operating time may be even shorter than that of conventional cervicotomy, but it must be kept in mind that it is a focused operation, not a bilateral exploration. These procedures are better performed under general anesthesia. Trocars are poorly tolerated by patients under local anesthesia. In addition, swallowing and spontaneous breathing present impediments when dissecting in such a small space.

The learning curve must be considered. First, one must emphasize the need for expertise when performing conventional open parathyroidectomy. Mentoring by a surgeon who has experience with endoscopic neck techniques is recommended. These new operations are technically more challenging than standard cervical exploration, and their performance should be confined to tertiary care centers.

The lateral approach is a rapid, direct, bloodless approach. In our opinion, it is the procedure of choice in most cases because it provides the best access to the posterior aspect of the thyroid lobe. It is therefore applicable in all cases in which the parathyroid lesions are located posteriorly—meaning the superior parathyroid glands—as their enlargement pushes them to migrate posteriorly and slide along the prevertebral plane next to the lateral esophageal border. The lateral approach is also ideal for inferior parathyroid glands located posterior to the inferior poles of the thyroid lobe. It is in these cases that they become intimate with the recurrent laryngeal nerve. The lateral view permits easy identification of the nerve abutting the adenoma and therefore allows a secure dissection.

The lateral approach is not suitable for superficially located parathyroid glands (i.e., the inferior glands located at the lower pole of the thyroid lobe or in the thyrothymic tracts). Early in our experience, we used the lateral approach for glands situated near the thymus: of the 14 undetected adenomas, 6 were in the thymus. These glands can easily be reached through a 15 mm skin incision at the suprasternal notch.

Not all patients presenting with PHPT are candidates for this surgery. Patients who are thought to have multiglandular disease are not eligible for these procedures. Endoscopic parathyroid procedures should be reserved for patients with sporadic PHPT. Other contraindications are the presence of a large goiter, previous surgery in the parathyroid vicinity, and equivocal preoperative localization studies. Depending on the operator's experience and according to the specific technique utilized, these contraindications can become relative. The central approach appears to be the best for cases in which bilateral exploration is anticipated or if localization is uncertain. Occasionally, endoscopic parathyroidectomy by the lateral approach can be performed in patients who have previously undergone a contralateral neck operation or tracheostomy. In our series, 10 patients with previous neck surgery underwent successful EPLA. According to some reports, more than 60% of patients with PTHP are candidates for video-assisted parathyroidectomy [24].

The endoscopic dissection of large adenomas (> 3 cm) can be difficult because the working area remains limited. With limited experience, some surgeons encounter major difficulty, which may lead to a capsular rupture and local seeding of parathyroid cells. When this occurs, conversion is recommended. Nevertheless, some large but elongated adenomas, especially those situated in the posterosuperior mediastinum, can be removed endoscopically. The pedicle can be easily dissected at the level of the inferior thyroid artery, and their shape is amenable to expeditious extraction. Absolute contraindications remain, including suspicion of a parathyroid carcinoma or a voluminous goiter, regardless of the experience of the surgeon or type of endoscopic technique employed. When parathyroid carcinoma is suspected during the endoscopic procedure, conversion is strongly recommended. When the diagnosis is made subsequently from the definitive section, it is advisable to reoperate to resect the structures adjacent to the tumor.

All endoscopic parathyroid surgeons believe that the adenoma should be clearly localized before the operation. Therefore the surgeon is highly dependent on the quality of the preoperative imaging to make a judicious choice for an endoscopic approach. Once contraindications have been eliminated, all patients with sporadic PHPT are considered candidates for this procedure. The choice between approaches depends on the quality and adequate interpretation of preoperative imaging studies. If cervical ultrasonography and nuclear scans do not correlate with a unique lesion at the same site, the traditional open cervical transverse incision is preferable. However, if the lesion is single and confirmed by both studies, the endoscopic approach can be proposed. Depending on a posterior or anterior location, one can choose a lateral or central approach.

Finally, endoscopic thyroidectomy and parathyroidectomy can be performed at the same time via the midline. These procedures are indicated for small, suspicious thyroid nodules less than 2.5 to 3.0 cm in diameter and associated with PHPT.

According to the various means of access, conversion to conventional parathyroidectomy is necessary in 8% to 15% of cases [24–26]. The main causes of conversion include difficulty with the dissection, false-positive imaging results, and multiglandular disease not detected by preoperative imaging but correctly predicted by the QPTH assay results. Therefore, as with other minimally invasive techniques, the availability of the QPTH assay is of utmost importance. The overall accuracy of intraoperative QPTH monitoring is reported to be 97% [27]. This test may be especially useful when localization studies are less certain. The risk of multiglandularity is nearly zero when ultrasonography and sestamibi scanning are positive for the same lesion. This figure has been found to be 3.6% when only one exploration is positive versus 31.6% when both tests are negative [28]: the less certain the localization studies, the more certain the need for QPTH.

The advantages to the patient of removing mediastinal parathyroid adenomas by thoracoscopy are irrefutable [29]. However, taking into account the excellent results of the traditional bilateral cervical exploration, the same advantages are more difficult to demonstrate for all cervical approaches. Two studies comparing conventional parathyroid surgery to endoscopic techniques have

clearly shown a diminution of postoperative pain and better cosmetic results with the endoscopic techniques [22, 30]. MIVAP is also associated with a shorter operating time [22]. Those results await confirmation by further randomized studies. As for the conventional operation, in most cases one night of hospitalization is necessary. Whether endoscopic techniques are less costly than conventional parathyroidectomy is questionable [22].

After surgery, more than 95% of patients are normocalcemic. However, it should be keep in mind that these excellent results were obtained in a group of carefully selected patients. They were chosen because they were thought to have sporadic PHPT with a solitary adenoma clearly localized by imaging studies. In addition, the risk of persistent PHPT was minimized by the use of intraoperative QPTH assessment.

Conclusions

In contrast to open surgery, where the surgeon alone is successful in more than 95% of cases [31], the endoscopic parathyroid surgeon depends on multiple technologies, including preoperative specialized imaging, intraoperative QPTH assessment, and special surgical instruments. The possible advantages of endoscopic parathyroidectomy are a better cosmetic result and more patient comfort. Endoscopic parathyroidectomy should not be considered in opposition to conventional parathyroidectomy. The two operations will probably turn out to be complementary in the future [32]. Endoscopic parathyroidectomy should be reserved for patients with sporadic PHPT who have a single adenoma clearly localized preoperatively. Among the many minimally invasive techniques applied to parathyroidectomy, the endoscopic technique has a major advantage in that it offers a magnified view that permits precise, careful dissection with minimal risks. The lateral approach is particularly suitable for patients with an adenoma located posteriorly in the neck. Central access is reserved for adenomas located inferoanteriorly. As for other minimally invasive techniques, a longer follow-up is needed before one can evaluate the real risk of recurrent PHPT following endoscopic techniques.

Résumé. Récemment plusieurs publications ont documenté la faisabilité de l'approche endoscopique pour les maladies de la parathyroïde. Nous avons réalisé une étude rétrospective pour évaluer les résultats de la parathyroïdectomie par voie endoscopique (PE) dans la prise en charge des nos patients porteurs d'hyperparathyroïdie primitive (PHPT). Pendant cinq ans (1998-2003), nous avons opéré 644 patients porteurs d'PHPT. La PE a été proposée lorsqu'il s'agissait d'un patient porteur de PHPT sporadique, sans goitre associé et sans antécédents de chirurgie cervicale, quand on a pu mettre en évidence un adénome solitaire par échographie et/ou scintigraphie au mibi. La PE a été réalisée par une approche latérale avec insufflation pour les patients avec adénome situé profondément dans le cou et par une approche médiane sans insufflation pour les patients porteurs d'adénome antérieur. Un dosage rapide de la parathormone (QPTH) a été réalisé pendant l'intervention. Parmi les 644 patients porteurs de PHPT, 279 (43.3%) n'étaient pas candidat à la PE. Les raisons ont été: goitre nodulaire associé (116 cas), antécédent de chirurgie du cou (52 cases), suspicion de maladie multiglandulaire (31 cas), absence de localisation préopératoire (61 cas) et causes diverses (19 cas). La PE a été réalisée chez 365 patients avec PHPT sporadique: 339 approches latérales, 25 approches médianes et une thoracoscopie ont été effectuées. La médiane de temps opératoire a été de 49 minutes (16–130). On a du convertir à une parathyroïdectomie conventionnelle chez 49 patients (13.4%). Les raisons de la conversion ont été: adénomes méconnus (14 cas), difficultés de dissection (8 cas), maladie multiglandulaire correctement prédite par le QPTH (11 cas), résultat faussement négatif au QPTH (4 cas), résultat faussement positif à la scintigraphie au mibi (11 cas) et un résultat faussement positif à l'échographie. Un patient a eu une paralysie du récurrent définitif. Trois patients sont restés hypercalcémiques et un autre avait une hypercalcémie récidivante. En conclusion, La PE peut être proposée chez plus de la moitié des patients porteurs de PHPT. Les résultats immédiats de la PE sont similaires à ceux obtenus par la parathyroïdectomie conventionnelle, mais aucune conclusion ne peut être tirée en terme d'influence de la PE sur l'évolution des patients opérés pour PHPT.

Resumen. En los últimos años diversas series han demostrado la factibilidad de los abordajes endoscópicos para las enfermedades paratiroideas. Hemos realizado un estudio retrospectivo con el fin de evaluar los resultados de la paratiroidectomía endoscópica (PE) en el manejo de nuestros pacientes con hiperparatiroidismo primario (PHPT). En el curso de un periodo de 5 años (1998–2003) operamos 644 pacientes con PHPT. Se propuso PE para pacientes con PHPT esporádico libres de bocio asociado y sin historia de cirugia cervical previa y en quienes se había localizado un adenoma único por medio de sonografía y centelleografía con sestamibi. Se practicó la PE por un abordaje lateral con insuflación en los pacientes con el adenoma previamente localizado. Se utilizó una determinación rápida de PTH en el curso de los procedimientos quirúrgicos. Entre 644 pacientes con PHPT, 279 (43.3%) no resultaron elegibles para PE: bocio nodular asociado (116 casos), cirugía cervical previa (52 casos), sospecha de enfermedad multiglandular (31 casos), ausencia de localización preoperatoria (61 casos) y causas misceláneas (19 casos). Se practicó PE en 365 pacientes con PHPT esporádico: 339 por acceso lateral, 25 por acceso de línea media y una toracoscopia. El tiempo operatorio medio fue 49 minutos (16–130). Se requirió conversión a paratiroidectomía convencional en 49 pacientes (13.4%): adenomas no visualizados (14 casos), dificultades en la disección (8 casos), enfermedad multiglandular establecida correctamente por la determinación intraoperatoria de PTH (11 casos); resultados falsos negativos de la determinación intraoperatoria de PTH (4 casos), resultados positivos falsos de la centelleografía con sestamibi (11 casos) y un resultado positivo falso de la sonografía. Un paciente presentó parálisis definitiva del nervio laringeo recurrente. Tres pacientes permanecieron hipercalcémicos y uno presentó hipercalcemia recurrente. En conclusión, la PE puede ser propuesta para más de la mitad de los pacientes con PHPT. Los resultados inmediatos de la PE son similares a los de la paratiroidectomía convencional, pero todavía no es posible derivar conclusiones en términos del efecto de la PE sobre la evolución final en pacientes operados por PHPT.

References

1. Tibblin SA, Bondeson AG, Ljunberg O. Unilateral parathyroidectomy in hyperparathyroidism due to single adenoma. Ann. Surg. 1982;195: 245–252
2. Russel CF, Laird JD, Fergusson WR. Scan-directed unilateral cervical exploration for parathyroid adenoma: a legitimate approach? World J. Surg. 1990;14:406–409
3. Chapuis Y, Richard B, Fulla Y, et al. Chirurgie de l'hyperparathyroïdie primaire par abord unilatéral sous anesthésie locale et dosage per opératoire de la PTH 1-84. Chirurgie 1993/1994;119:121–124
4. Udelsman R, Donovan PI, Sokoll LJ. One hundred consecutive minimally invasive parathyroid explorations. Ann. Surg. 2000;232:331–339
5. Inabnet WB, Biertho L. Chirurgie parathyroïdienne dirigée: une série de 100 patients consécutifs. Ann. Chir. 2002;127:751–756
6. Ikeda Y, Takami H, Tajima G, et al. Direct mini-incision parathyroidectomy. Biomed. Pharmacother. 2002;56:14s–17s
7. Norman J, Chheda H. Minimally invasive parathyroidectomy facilitated by intraoperative nuclear mapping. Surgery 1997;122:998–1004
8. Burkey SH, Van Heerden JA, Farley DR, et al. Will directed parathyroidectomy utilizing the gamma probe or intraoperative parathyroid hormone assay replace bilateral cervical exploration as the preferred operation for primary hyperparathyroidism? World J. Surg. 2002;26: 914–920
9. Gagner M. Endoscopic parathyroidectomy. Br. J. Surg. 1996;83:875
10. Miccoli P, Bendinelli C, Vignali E, et al. Endoscopic parathyroidectomy: report of an initial experience. Surgery 1998;124:1077–1080
11. Henry JF, Defechereux T, Gramatica L, et al. Parathyroïdectomie vidéo-assistée par abord latéro-cervical. Ann. Chir. 1999;53:302–306
12. Cougard P, Goudet P, Osmak L, et al. La vidéo-cervicoscopie dans la

chirurgie de l'hyperparathyroïdie primitive: etude préliminaire portant sur 19 patients. Ann. Chir. 1998;52:885–889
13. Gauger PG, Reeve TS, Delbridge LW. Endoscopically-assisted minimally invasive parathyroidectomy. Br. J. Surg. 1999;86:1563–1566
14. Duh QY. Videoscopic parathyroidectomy: rationales, techniques, indications and contraindications. Acta Chir. Austriaca 1999;31:214–217
15. Lorenz K, Nguyen-Thanh P, Dralle H. First experience with minimally invasive video-assisted parathyroidectomy. Acta Chir. Austriaca 1999; 30:218–220
16. Yeung GHC. Endoscopic surgery of the neck: a new frontier. Surg. Laparosc. Endosc. 1998;8:227–232
17. Okido M, Shimizu S, Kuroki S, et al. Video-assisted parathyroidectomy for primary hyperparathyroidism: an approach involving a skin-lifting method. Surg. Endosc. 2001;15:1120–1123
18. Ikeda Y, Takami H, Tajima G, et al. Total endoscopic parathyroidectomy. Biomed. Pharmacother. 2002;56:22s–25s
19. Suzuki S, Fukushima T, Ami H, et al. Video-assisted parathyroidectomy. Biomed. Pharmacother. 2002;56:18s–21s
20. Miccoli P, Bendinelli C, Conte M. Endoscopic parathyroidectomy by a gasless approach. J. Laparoendosc. Adv. Surg. Tech. A 1998;8:189–194
21. Henry JF. Endoscopic exploration. In Van Heerden JA, Farley DR, editors, Operative Technique in General Surgery: Surgical Exploration for Hyperparathyroidism, Philadelphia, Saunders, 1999;49–61
22. Miccoli P, Bendinelli C, Berti P, et al. Video-assisted versus conventional parathyroidectomy in primary hyperparathyroidism: a prospective randomized study. Surgery 1999;126:1117–1122
23. Lorenz K, Nguyen-Thanh P, Dralle H. Unilateral open and minimally invasive procedures for primary hyperparathyroidism: a review of selective approaches. Langenbecks Arch. Surg. 2000;385:106–117
24. Miccoli P, Berti P, Conte M, et al. Minimally invasive video-assisted parathyroidectomy: lesson learned from 137 cases. J. Am. Coll. Surg. 2000;191:613–618
25. Cougard P, Goudet P, Bilosi M, et al. Exérèse vidéoendoscopique des adénomes parathyroïdiens: résultats àpropos d'une série prospective de 100 patients. Ann. Chir. 2001;126:314–319
26. Henry JF, Lacobone M, Mirallié E, et al. Indications and results of video-assisted parathyroidectomy by a lateral approach in patients with primary hyperparathyroidism. Surgery 2001;130:999–1004
27. Irvin GL, Carneiro DM. Rapid parathyroid hormone assay guided exploration. In Van Heerden JA, Farley DR, editors, Operative Technique in General Surgery: Surgical Exploration for Hyperparathyroidism, Philadelphia, Saunders, 1999;18–27
28. Sebag F, Hubbard JGH, Maweja S. Negative preoperative localization studies are highly predictive of multiglandular disease in sporadic primary hyperparathyroidism. Surgery 2003;134:1038–1042
29. Prinz RA, Longhyna V, Carnaille B, et al. Thoracoscopic excision of enlarged mediastinal parathyroid glands. Surgery 1994;116:999–1004
30. Henry JF, Raffaelli M, Iacobone M, et al. Video-assisted parathyroidectomy via lateral approach versus conventional surgery in the treatment of sporadic primary hyperparathyroidism: results of a case-control study. Surg. Endosc. 2001;15:1116–1119
31. Van Heerden JA, Grant CS. Surgical management of primary hyperparathyroidism: an institutional perspective. World J. Surg. 1991;15: 688–692
32. Henry JF, Sebag F, Maweja S, et al. Video-assisted parathyroidectomy in the management of patients with primary hyperparathyroidism. Ann. Chir. 2003;128:379–384