ORIGINAL ARTICLE

Minimally invasive video-assisted subtotal parathyroidectomy with thymectomy for secondary hyperparathyroidism

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Abstract

Background Secondary hyperparathyroidism (sHPT) is common in patients with chronic renal failure. Bilateral cervical exploration is optimal for patients with sHPT. The aims of this clinical trial are to evaluate the feasibility of video-assisted subtotal parathyroidectomy as an alternative surgical treatment for sHPT.

Methods This prospective study included 12 consecutive patients with sHPT. Surgical indications included a high intact parathormone level, enlarged parathyroid glands, high bone turnover and conditions refractory to medical treatment of hypercalcemia and hyperphosphatemia.

Results All patients underwent minimally invasive video-assisted subtotal parathyroidectomy and trans-cervical thymectomy. Four cervical glands were found in all patients and intrathymic glands were identified in three (25%) patients.

Conclusion Minimally invasive video-assisted subtotal parathyroidectomy offers an alternative method, and this technique can be performed safely for sHPT.

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Introduction

Secondary hyperparathyroidism (sHPT) is common in patients with chronic renal failure [1, 2]. Despite the advent of new therapeutic agents including calcimimetics, new phosphate binders, and less calcemic vitamin D analogues, patients with long-standing sHPT often require parathyroidectomy [3]. The indication for surgery depends on clinical symptoms of progressive osteitis fibrosa and impaired calcemic response following PTH secretion in the absence of vitamin D deficiency [4]. Subtotal parathyroidectomy and total parathyroidectomy with autotransplantation are currently considered as the standard procedures in the treatment of sHPT [5, 6].

Minimally invasive parathyroidectomy (MIP) for primary hyperparathyroidism has become an accepted part of endocrine surgical practice worldwide; however, this technique is not offered to the patients with sHPT [7–11]. There is clinical evidence that demonstrate MIP for sHPT is as safe as a bilateral parathyroid exploration. The aims of this technical trial are to evaluate the feasibility of minimally invasive video-assisted subtotal parathyroidectomy as an alternative surgical treatment for sHPT.

Materials and methods

Patients

Between January 2007 and January 2008, 12 patients underwent subtotal parathyroidectomy and trans-cervical

thymectomy for advanced renal hyperparathyroidism in the Department of General Surgery at the Istanbul Medical Faculty. Exclusion criteria were previous neck surgery and refusal to participate in this study. Surgical indications included a high intact parathormone (PTH) level, enlarged parathyroid glands, high bone turnover, and conditions refractory to medical treatment of hypercalcemia and hyperphosphatemia. All patients were treated before surgery with supplementary calcium and vitamin D for at least 2 years and underwent neck surgery during treatment with hemodialysis. Most of the patients complained of bone pain and muscle weakness.

In all patients, indirect laryngoscopic examination was used to evaluate vocal cord motility both before and after surgery. In cases of dysphonia with vocal cord injury, indirect laryngoscopy was also performed between 1 and 6 months later. Persistent nerve palsy was defined as persistent dysfunction and clinical dysphonia that lasted for 6 months postoperatively. Hypocalcemia was defined as a serum calcium level <8 mg/dl after the operation. The presence of clinical symptoms or signs of hypocalcemia were noted. Persisting hyperparathyroidism was defined when the PTH level did not drop to an acceptable level.

Persistent hypoparathyroidism was defined as serum parathyroid hormone levels below 10 pg/ml in patients requiring treatment for more than 3 months to maintain normocalcemia. The ethics committee of our institution approved of the study and informed consent was obtained from all patients participating in the trial.

Biochemical analysis

Serum calcium, alkaline phosphatase, and phosphorus levels were determined by auto-analyzer (Cobas Integra 800, Roche Diagnostics, Basel, Switzerland). Serum PTH level was determined by immunoradiometric assay using a commercially available kit (IRMA kit, BioSource Europe S.A., Nivelles, Belgium). Normal ranges of biochemical parameters were 8.5–10.5 mg/dl for serum calcium, 90–260 U/l for serum alkaline phosphatase, 0.6–1.5 mg/dl for serum phosphorus, and 10–65 pg/ml for serum PTH concentrations.

Surgical technique

All patients underwent minimally invasive video-assisted subtotal parathyroidectomy performed by the same surgeon.
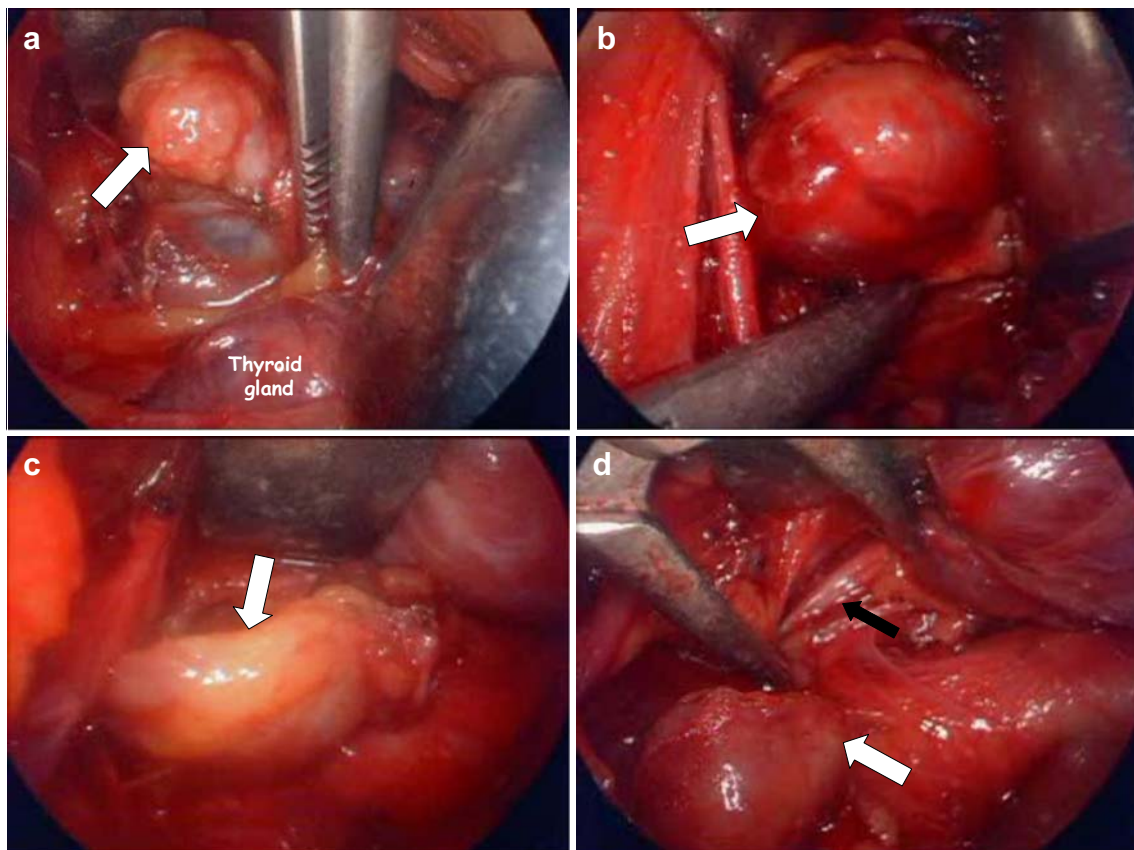
Fig. 1 a and b Dissection of the right thyrotracheal groove. Superior (a) and inferior (b) parathyroid gland (*white arrow*); c and d dissection of the left thyrotracheal groove. Superior (c) and inferior (d) parathyroid gland (*white arrow*) and recurrent laryngeal nerve (*black arrow*)

A 20-mm skin incision was made 2 cm above the sternal notch and the cervical midline was divided. The strap muscles are separated from the thyroid lobe by gentle blunt dissection, performed under direct vision, on both sides. The operative field was maintained by external retraction with a gasless technique. A 5-mm 30° scope and surgical instruments were inserted through the incision. Dissection of the thyrotracheal groove was achieved under endoscopic vision. The bilateral neck exploration was performed via the same central neck access. After visualization of the four parathyroid glands (Fig. 1), subtotal parathyroidectomy (Fig. 2) and cervical thymectomy were performed by video-assisted and direct vision. During bilateral exploration, the largest gland was visualized and selected for subtotal resection. Since it is very important to avoid injury to the

Fig. 2 a Subtotal resection; b completed subtotal parathyroidectomy

parathyroid gland capsule during the initial operation, we avoided contamination of the operative field of parathyroid cells. The fibrous cords then were dissected at the level of the inferior poles of the thyroid from both sides and removal of all the cervical thymic tissue was completed. The recurrent laryngeal nerves were identified in all patients. Hemostasis was performed using the Harmonic Focus (Ethicon Endo Surgery, US) and conventional vascular clips. The wound length was measured at the end of the surgery.
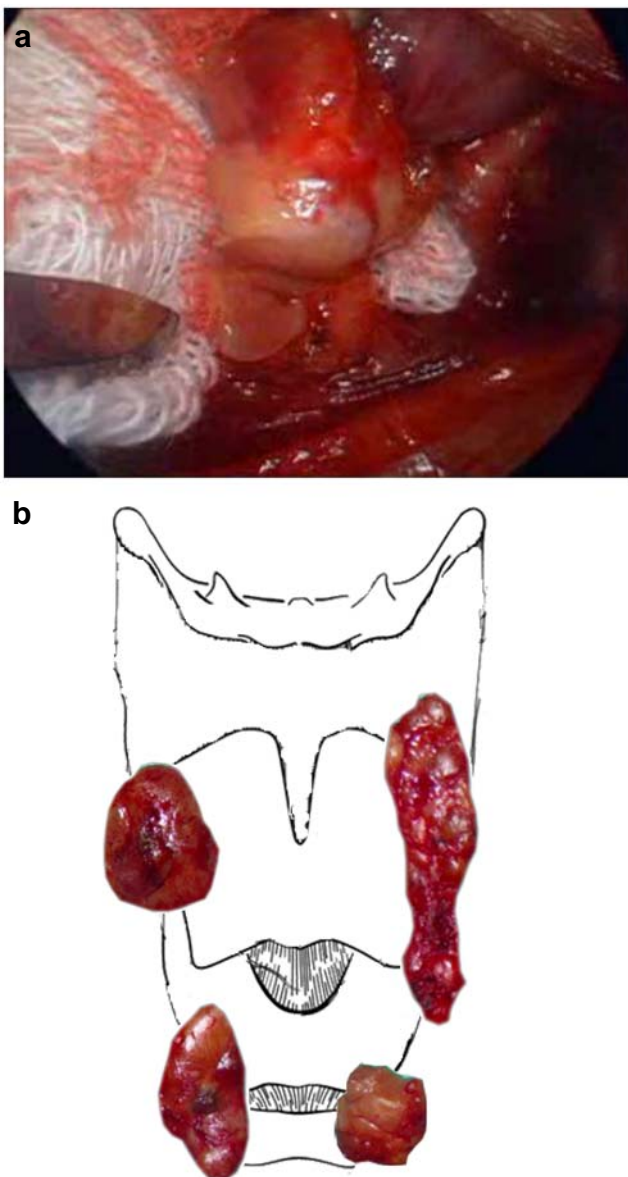
Results

Patients

The mean±SD age was found 44.2±14 years for 12 patients (range 16–65 years). The female/male ratio was 0.7/1 ($n=6/8$). The mean±SD of serum calcium, phosphorus, PTH, and alkaline phosphatase levels were found 10.7±1 mg/dl, 5.5±1 mg/dl, 1661±712 pg/dl, and 687± 274 U/l, respectively. Most of the patients were symptomatic. Bone pain and muscle weakness were recorded in seven and 11 patients, respectively.

The video-assisted procedure was successfully performed in all patients by the same surgical team. Trans-cervical thymectomy and subtotal parathyroidectomy were performed leaving a remnant the size of two normal parathyroid glands at a single site. Four cervical glands were found in all patients. Moreover, we have found an ectopic intrathymic parathyroid gland. The total excised parathyroid tissue weighed 914.58±647 mg. Mean operative time was 97.5±22 min. The length of incision was 27.1±2 mm at the end of the procedure. The length of incision at the end of the surgery was longer than at the beginning of the surgery ($p<0.001$; paired t test). On microscopic examination, hyperplastic glands were found in all patients and intrathymic glands were identified in three (25%) patients. The histopathological examinations of cervical thymic tissues were found normal.

There were no postoperative deaths. The mean hospital stay was 5±1.2 days. Only one patient (8.3%) had a transient vocal cord paralysis. All of them were followed up between 6 and 32 months (15.8±6.9 months). No patient was hypercalcemic at follow-up. Mean postoperative serum calcium and PTH levels were found to be 8.5±0.4 mg/dl and 98±43 pg/dl, respectively. Based on PTH values, one patient (8.3%) had hypoparathyroidism.

Discussion

sHPT is a severe and frequent complication in patients with advanced chronic kidney disease, characterized by hyper-

plasia of all parathyroid glands and elevated serum parathyroid hormone levels. An estimated 2.5% to 8% of all patients with chronic kidney disease finally undergo surgery for sHPT [1, 2].

Subtotal parathyroidectomy and total parathyroidectomy with autotransplantation are both accepted operations for sHPT [4, 5]. The pathophysiological stimuli influence all parathyroid tissue and, fundamentally, all glands are hyperplastic. Thus, supernumerary glands are more important in sHPT than in primary HPT [4–6]. The surgeon must be skilled in carrying out a complete cervical exploration to carry out the standard subtotal and total parathyroid resections. Operative success can be improved with an adequate cervical exploration. A missed supernumerary parathyroid gland could contribute to surgical failures. Careful examination of the surgical site for supernumerary glands is also essential. The most common location is the thymus. The current opinion is that trans-cervical removal of thymic tissue is the best way to avoid this type of surgical failure. Consequently, bilateral cervical exploration is optimal for patients with sHPT [12, 13]. We also performed bilateral cervical exploration and cervical thymectomy.

Since 1925, when Felix Mandl [14] of Vienna performed the first parathyroidectomy, the surgical technique of parathyroidectomy traditionally has involved bilateral exploration of the neck with the intent of visualizing all parathyroid glands and resecting pathologically enlarged glands. Subtotal parathyroidectomy and total parathyroidectomy with autotransplantation are both accepted operations for sHPT. Total parathyroidectomy with autotransplantation is the best procedure for treating recurrences, but the increased risk of hypoparathyroidism must be kept in mind. It is mandatory to cryopreserve some tissue to avoid the risk of hypocalcemia. Long-term results with total and subtotal parathyroidectomy are likely to be similar. The most frequent complication is that of persistent or recurrent sHPT; which generally occurs in less than 10% of patients after subtotal parathyroidectomy or total parathyroidectomy and autotransplantation [4–6, 12, 13].

In both subtotal and total parathyroidectomy, it is very important to identify all parathyroid glands including supernumerary glands at the initial operation. It is mandatory to cryopreserve some tissue to avoid the risk of hypocalcemia in total parathyroidectomy. However, the cryopreserved tissue may not function as well as primary autotransplanted parathyroid tissue, particularly after months of cryopreservation [11–13].

On the other hand, the improvement of preoperative localization imaging studies, quick intraoperative measurement of parathormone and the use of the intraoperative gamma probe have increased the number of reports describing MIP [12, 13, 15, 16]. MIP is characterized by

a smaller neck incision and access through an endoscopic or video-assisted approach. Advantages of MIS include a small wound, limited surgical dissection, minimal postoperative pain, and shorter hospital stay [7–10]. Miccoli et al. [15] first described central access which allows a bilateral exploration of the neck when necessary. They suggested that the operative field be completely exposed, with the carotid artery laterally, vertebral plane posteriorly, and thyrotracheal groove medially exposed. Bilateral exploration could be achieved through the central incision by changing the position of the small retractors. Although the surgical technique was first described by Miccoli [15], the published experience on sHPT is limited [17–20].

The MIP technique with qPTH has proven to be effective in the treatment of pHPT [7–10]. However; it is accepted that this approach may lack in effectiveness in patients with a double gland or multiglandular disease.

Miccoli et al. [21] recently published a prospective trial comparing endoscopic bilateral neck exploration versus focused parathyroidectomy plus qPTHa during minimally invasive video-assisted parathyroidectomy The results of their experience prove that bilateral exploration can be performed video-assisted, avoiding both the time necessary for qPTHa and its cost. The low risk of persistent HPT will make this is an attractive option for all institutions where a minimally invasive technique is routinely performed.

In conclusion, video-assisted bilateral neck exploration was completed successfully in all 12 patients with sHPT. This favorable experience led us to initiate further studies to evaluate the efficacy and rationale of video-assisted parathyroidectomy compared to conventional bilateral exploration for parathyroidectomy in sHPT patients.

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