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SURGICAL ENDOSCOPY
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Video-assisted thyroidectomy for papillary thyroid carcinoma

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Abstract
Background: In patients with small papillary thyroid carcinomas (PTC), we evaluated the operative feasibility and safety of video-assisted thyroidectomy (VAT) and the completeness of the surgical resection.
Methods: Video-assisted thyroidectomy was attempted in 24 patients with thyroid malignancy. Total thyroid resection for PTC was achieved completely by VAT in 20 of them, who were included in this study.
Results: In this study, 12 total thyroidectomies and 8 lobectomies followed by completion thyroidectomies were performed. Eight patients also underwent central neck lymph node dissection. Mean postoperative serum thyroglobulin was 0.2 ng/ml for patients receiving LT4 suppressive treatment and 4.2 ng/ml for patients after LT4 withdrawal. Postoperative ultrasonography showed no residual thyroid tissue. The mean radioiodine uptake at postoperative scintiscan was 2.2%.
Conclusions: In the case of PTC, VAT is feasible and safe. The completeness of the surgical resection seems comparable with that reported for conventional surgery. Nevertheless, larger series and longer follow-up evaluation are necessary for definitive conclusions to be drawn about its oncologic validity.

Key words: Video-assisted thyroidectomy — Endoscopic thyroidectomy — Papillary thyroid carcinoma

Several techniques for endoscopic and video-assisted thyroid surgery have been proposed since 1997 [5, 7, 9, 10, 17, 20]. Although these techniques are indicated only for a minority of patients, recent prospective studies have demonstrated that video-assisted [3, 13] and endoscopic procedures [7] for thyroidectomy have some advantages over conventional surgery in terms not only of cosmetic result, but also of postoperative pain and recovery.

Some authors [7] consider thyroid malignancy to be a contraindication for video-assisted or endoscopic surgery, but we [4] and others [3, 12, 18] have demonstrated that video-assisted thyroidectomy (VAT) is feasible and safe in the case of small papillary thyroid carcinomas (PTCs). Moreover, we have reported that central neck lymph node removal also is feasible, with no additional risk of complications in patients with PTC [4]. These results have been confirmed by other experiences [18].

However, despite the encouraging results, some doubts still exist about the oncologic validity of these procedures. Indeed, even if VAT repeats the conventional operation, in each step, it has not yet been demonstrated whether it completely satisfies the criteria of oncologic radicality.

Obviously, a major concern is whether the video-assisted approach can achieve a thyroid resection as complete as conventional surgery. In this study, we prospectively evaluated the results obtained in patients who underwent VAT for PTC to verify the completeness of the surgical resection, as well as the feasibility and safety of the video-assisted approach.

Materials and methods

The eligibility criteria for VAT were: thyroid nodules smaller than 35 mm in their maximum diameter, thyroid volume within normal range ($\leq$20 ml), no history of neck irradiation, no thyroiditis. Between June 1998 and April 2002, VAT was attempted in 81 patients. The final histology showed malignancy in 24 cases (29.6%). Total thyroid resection was achieved by a video-assisted procedure in 20 patients, who were included in this study.

Data from the 20 patients were prospectively recorded. The following parameters were registered: age, gender, preoperative diagnosis, mean maximum diameter of the nodule (as evaluated by preoperative ultrasound), type of operation (lobectomy and successive completion thyroidectomy or total thyroidectomy with or without central neck lymph node removal), operative time, postoperative complications, postoperative stay, final histology, tumor stage, patient satisfaction with the cosmetic result, postoperative serum thyroglobulin under

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L-thyroxine (LT4) and after LT4 suppressive treatment withdrawal, and radioiodine test uptake (RAIU) result.

The procedure has already been described [4]. Briefly, VAT is performed through a single horizontal 1.5- to 2.0-cm skin incision above the sternal notch, in the midline. After division of the cervical linea alba, the operative space is maintained by means of conventional retractors, without any trocar insertion. A 30° 5-mm endoscope is inserted through the single skin incision, as well as the dedicated (diameter, 2–3 mm) surgical instrumentation (forceps, scissors, spatulas, spatula-shaped aspirator) derived from conventional ear, nose, and throat instruments. Dissection is performed under endoscopic vision. The Harmonic Scalpel (curved shears, 14 cm), with curved shears and a scissor-grip handle (Ethicon Endo-Surgery, Cincinnati, OH, USA) is used for division of vessels and hemostasis. Conventional clips may be useful as well as conventional ligatures, especially when dissection is very close to the recurrent laryngeal nerve. The steps of the procedure are similar to those of conventional surgery [4]. The endoscopic magnification allows for very easy identification and preservation of the laryngeal nerves (external branch of the superior laryngeal nerve and inferior recurrent laryngeal nerve) and parathyroid glands.

When enlarged lymph nodes in the central compartment (recurrent nodes and pretracheal nodes) are identified, they are dissected and removed by the same video-assisted procedure. We usually remove enlarged central neck lymph nodes also in the case of nodules suspected of malignancy, but not surely malignant. Tumor stage is defined according to TNM classification [19].

In the current study, postoperative serum calcium and phosphorus were measured in all the patients. Hypocalcemia was defined as a serum calcium level lower than 8.0 mg/dl. Laryngoscopy was performed postoperatively to check vocal cord motility in all the patients.

Serum thyroglobulin under suppressive LT4 treatment was measured in all the patients. Ultrasound scan was performed in all the patients 1 to 6 months after surgery. Patients were selected for radioiodine treatment on the basis of prognostic factors [15]. In our Center, all patients with PTC are treated with radioiodine, with the exception of patients who have pT1aN0M0 PTC [15]. The first radioiodine treatment is performed 2 to 6 months after the operation.

Radioiodine therapy is performed with the patient in a hypothyroid condition (thyroid- stimulating hormone (TSH) >30 international unit (IU)/ml), obtained with suspension of LT4 suppression therapy. Before treatment, in a hypothyroidism condition, all the patients have a 24-h RAIU test as well as TSH, serum thyroglobulin, and Anti-Tg antibodies measurement. In an hospitalization regimen, all the patients are treated with a fixed dose of radioiodine (1,850 or 3,700 MBq), adjusted on the basis of prognostic factors, RAIU test result, and levels of serum thyroglobulin. A posttreatment whole-body scan (PT-WBS) is performed at discharge.

All the patients who have undergone total thyroid ablation (total thyroidectomy + radioiodine treatment) are evaluated 6 to 12 months after the first radioiodine treatment with a diagnostic I131-WBS (185 MBq) and measurement of serum thyroglobulin after LT4 withdrawal. Criteria for a successful ablation are absence of activity in the thyroid bed, a quantitative RAIU below 0.2%, and undetectable serum thyroglobulin after LT4 withdrawal. All the patients were asked to evaluate the cosmetic result of the procedure by means of a numeric scale 1 to 6 months after surgery. This scale had a range of 0 to 10.

Results

Among the patients in whom VAT was attempted and malignancy was demonstrated at the final histologic assessment, there were 23 women and 1 man, with a mean age of 42.8 years (range, 26–70). Of the 24 patients, 13 (54.2%) underwent total thyroidectomy as a single procedure, because of malignancy demonstrated at preoperative cytology or intraoperative frozen section examination. The remaining 11 patients (45.8%) underwent thyroid lobectomy followed by completion thyroidectomy, because of malignancy found at the final histologic assessment. Conversion to an open procedure was required in one patient because of large nodule size and thyroid volume that had been underestimated by preoperative imaging studies (ultrasound). This patient underwent total thyroidectomy, and the final histologic assessment showed a follicular carcinoma (pT2a).

Completion thyroidectomy was performed in three cases by a conventional procedure because at the beginning of the experience we were concerned about the feasibility of VAT in the case of redo surgery. In these patients, the final histologic assessment showed a follicular variant of PTC (pT2a in 2 cases, pT2b in the remaining case). Eight patients underwent video-assisted completion thyroidectomy, 1 to 2 months after the first operation. Thus, in 20 patients, total thyroid removal was achieved by the video-assisted approach (video-assisted total thyroidectomy in 12 cases and video-assisted thyroid lobectomy followed by video-assisted completion thyroidectomy in 8 cases). These 20 patients were included in this study.

The 20 patients were women with a mean age of 41.2 years (range, 26–70). In these patients, the preoperative diagnosis was PTC in 3 cases (15.0%), suspicion of a follicular variant of PTC (follicular nodules with nuclear pleomorphism) [6] in 11 cases (55.0%), and a follicular (indeterminate) lesion in 6 cases (30.0%). The mean maximum diameter of the lesion was 16.8 mm (range, 9–26). The mean operative time was 86 min for lobectomy (range, 50–150), 102 min for total thyroidectomy (range, 70–220), and 79 min for completion thyroidectomy (range, 50–100). Eight of these patients also underwent central neck lymph node removal by the video-assisted approach because of enlarged lymph nodes found unexpectedly during the operation. Lymph node removal required about 15 min in all the cases.

The final histologic assessment showed two pT1b, nine pT2a, seven pT2b, and two pT4 PTCs. Lymph node micrometastases were found in two patients (2 metastasized lymph nodes in each patient): one case of pT2a PTC and one case of pT4 PTC. Reactive changes were found in the remaining six patients, from whom central neck lymph nodes were removed.

Three transient postoperative hypocalcemias that required vitamin D and oral calcium supplementation were registered. In all of these cases, calcium and vitamin D supplementation was discontinued within 1 month. No other complication occurred. Postoperative laryngoscopy showed normal motility of the vocal cords in all the patients. The mean postoperative hospital stay was 2.2 days (range, 2–5).

The mean follow-up period was 12.2 months (range, 6–24), and the mean postoperative serum thyroglobulin with LT4 suppressive treatment was 0.2 ng/ml (range, 0–1.5). Postoperative ultrasonography showed no residual thyroid tissue or evidence of recurrence in any of the patients.

For all these patients, an RAIU test was obtained while they were in a hypothyroid condition. The mean uptake at postoperative iodine scintiscan was 2.2% (range, 0–9.1%). The mean postoperative thyroglobulin after LT4 withdrawal was 4.2 ng/ml (range, 0–12.5). However, only one patient had an uptake higher than 4.5% (9.1%) and a serum thyroglobulin after LT4

withdrawal higher than 10 ng/ml (12.5 ng/ml). This patient was the first in whom completion thyroidectomy was performed by the video-assisted approach (lobectomy and successive completion thyroidectomy). Radioiodine scintiscan performed 1 year after total thyroid ablation (VAT + radioiodine therapy) showed no residual thyroid tissue (RAIU, 0%) and undetectable serum thyroglobulin (< 0.1 ng/ml) after LT4 withdrawal. Diagnostic I131-WBS was performed in two additional patients 6 to 12 months after total thyroid ablation. In these patients, ablation was demonstrated to be successful.

The patient with a pT4Nx PTC had a preoperative diagnosis of PTC, without any sign of extrathyroidal invasion. She underwent video-assisted total thyroidectomy. Postoperative ultrasonography showed no evidence of recurrence or residual thyroid tissue. Serum thyroglobulin was undetectable with the patient on LT4 and 7.1 ng/ml after LT4 withdrawal. The quantitative RAIU was 4.5%.

The patient with a pT4N1 PTC showed a serum thyroglobulin level after LT4 withdrawal of 3.4 ng/ml, with a quantitative RAIU of 2.0%. Serum thyroglobulin with the patient receiving LT4 treatment was undetectable, and the postoperative ultrasound scan showed no residual thyroid tissue or recurrent disease in the thyroid bed. The patient had a preoperative diagnosis of follicular nodule with nuclear pleomorphism in a small multinodular goiter and underwent one-step thyroidectomy.

The second patient with central neck lymph node metastases had a preoperative diagnosis of PTC without any evidence of lymph node involvement at the preoperative ultrasound scan. She had undetectable serum thyroglobulin under LT4 suppressive treatment. No residual thyroid tissue or recurrent disease in the thyroid bed was demonstrated by postoperative ultrasound scan. Serum thyroglobulin after LT4 withdrawal was 7.6 ng/ml, and quantitative RAIU was 2.0%.

All the patients considered the cosmetic result as excellent. The mean visual analogue scale score for the cosmetic result was 9.3 (range, 8–10).

Discussion

Over the past 5 years, several techniques for video-assisted and endoscopic thyroid surgery have been proposed [5, 7, 9, 10, 17, 20]. Recently, published prospective studies have reported that these techniques have some advantages over conventional surgery in terms of cosmetic result and postoperative outcome [3, 13]. A quite large multiinstitutional series demonstrated that VAT is a wellreproducible procedure, and that it is as safe as conventional surgery, even when performed in different surgical settings [12]. Nonetheless, at least at the moment, video-assisted procedures are indicated only in a minority of patients with thyroid diseases. Indeed, nodule size and thyroid volume are the most important limiting factors. Video-assisted thyroidectomy is indicated for small thyroid nodules harboring in normal or slightly enlarged thyroid glands. Such conditions usually are encountered in the case of small solitary nodules found incidentally at neck ultrasonography that have been referred to surgery because of suspicious or malignant cytology. Thus, paradoxically, small suspicious or malignant nodules could, from a technical point of view, be one of the best indications for VAT.

Nevertheless, it is clear that, as with other applications of minimally invasive surgery, there are some concerns about the feasibility and safety of VAT in the case of malignant diseases, at least at the beginning of the experience. First of all, during the first phase of our experience, we and other authors [4, 7], were concerned about the possibility of performing a total thyroidectomy, or even a completion thyroidectomy, of a previous video-assisted thyroid lobectomy, by the video-assisted approach. Nevertheless, with increasing experience, we felt more confident with the procedure, which is identical in each step to conventional surgery. For this reason, we decided to widen the indication for VAT. Indeed, after an adequate learning period (30 cases), we began to complete the thyroidectomy by the video-assisted approach in cases of positive frozen section. We also chose to use the video-assisted approach for completion thyroidectomy of previous video-assisted thyroid lobectomy in cases of malignancy found at the final histologic assessment. After demonstrating that total thyroidectomy could be performed safely by the video-assisted approach, we decided to propose this procedure also for cases of small (T1 to small T2) PTCs without any evidence of lymph node involvement at preoperative ultrasonography.

Indeed, total thyroidectomy is considered the preferable initial surgical approach for patients with PTC when there is no gross evidence of lymph node metastases [2, 11, 14, 16]. However, despite the fact that VAT repeats conventional surgery in all its steps, the completeness of the surgical resection realized by the video-assisted approach and its appropriateness for the treatment of small PTCs have been questioned by some experts [3, 13]. This study thus was conducted to verify the results of VAT in terms of completeness of thyroid tissue removal, and to determine the operative feasibility and safety of the procedure. The results obtained are similar to those reported for conventional surgery in the literature.

Before Iodine-131 treatment (total thyroid ablation), serum thyroglobulin during LT4 suppression therapy was undetectable in most of the patients in this series. After LT4 suppression withdrawal (TSH > 30 IU/1), the mean serum thyroglobulin level was low (4.2 ng/ml), remaining undetectable in most patients. These results are comparable with those reported for conventional surgery [8].

Postoperative ultrasonography, performed 1 to 6 months after surgery, showed no residual thyroid tissue or evidence of recurrence in any of the patients. It is well known that most patients who have undergone conventional total or near-total thyroidectomy for differentiated carcinomas have a thyroid bed uptake that requires radioiiodine remnant ablation [16]. The percentage of neck RAIU is proportional to the mass of the residuum [8]. Thus, postoperative RAIU can be used to

assess the completeness surgery in patients who undergo total thyroidectomy for PTC [1]. In this series, the mean RAIU at the postoperative iodine scintiscan was 2.2% (range, 0–9.1%). Most of the patients (15/20; 70.0%) had a thyroid bed RAIU less than 2.0%. This is particularly relevant because some have advocated radioiodine treatment (thyroid remnant ablation) only for patients with a neck uptake exceeding 2% [1]. Moreover, all but one patient (19/20; 95.0%) had a thyroid bed RAIU less than 4.5%. These results can rival those reported for conventional surgery [1]. Indeed, the mean thyroid bed RAIU in patients who have undergone conventional total thyroidectomy reportedly is 7% in many experiences [14], and a thyroid bed RAIU exceeding 4% has been reported for up to 43.5% of the patients who have undergone total thyroidectomy [8].

In the current series, only one patient had an RAIU higher than 4.5% (9.1%) and a serum thyroglobulin after LT4 withdrawal higher than 10 ng/ml (12.5 ng/ml). This patient was the first in whom completion thyroidectomy was performed by the video-assisted approach (lobectomy and successive completion thyroidectomy). Radioiodine scintiscan performed 1 year after total thyroid ablation (VAT + radioiodine therapy) showed no residual thyroid tissue (RAIU, 0%) and undetectable serum thyroglobulin (<0.1 ng/ml) after LT4 withdrawal, thus confirming the successful ablation. Moreover, diagnostic I131-WBS performed in two additional patients 6 to 12 months after total thyroid ablation confirmed successful ablation in both (no residual thyroid bed RAIU and undetectable thyroglobulin).

Quite unexpectedly, the results of VAT were excellent also in case of advanced disease. Indeed, in this series we had a patient with a pT4Nx PTC and two patients with central neck lymph node metastases (1 pT2aN1 and 1 pT4N1 PTC). Obviously, these patients were selected for VAT because there was no evidence of extrathyroidal invasion or lymph node metastases at the preoperative workup. Because thyroid capsule invasion in both pT4 cases was only microscopically diagnosed, and because the metastatic nodes were only slightly enlarged and showed micrometastases at the final histologic assessment, it was not possible to diagnose this involvement preoperatively. However, the surgical resection, evaluated by postoperative ultrasound scan, serum thyroglobulin with and without LT4 therapy, and RAIU, seems to be as accurate and complete as with conventional surgery also in this group of patients.

Although we believe that VAT still is indicated only for the treatment of less advanced disease (T1 to small T2 PTC), these results are very encouraging. This underlines once more that the operation we can perform by the video-assisted approach is substantially identical to the procedure we perform in conventional surgery. Furthermore we have demonstrated that it is possible to use the video-assisted approach also for removal of the central neck lymph node, when appropriate.

The results of this study confirm that VAT is as safe as conventional surgery, and that if allows for an excellent cosmetic result. Indeed, postoperative complications included only three cases of transient postoperative hypocalcemia. No other complication occurred. These results compare well with those reported for conventional surgery in the recent literature, especially when it is considered that the morbidity associated with thyroidectomy is higher in patients who undergo thyroidectomy for malignancy and in cases of central neck dissection. The cosmetic result was considered excellent by all the patients.

However, it should be considered that the most important point from an oncologic point of view, is the completeness of surgery. If during VAT the dissection cannot be as accurate as with conventional surgery, conversion is mandatory. Indeed, to achieve the best results, an adequate learning period and appropriate training are necessary. Moreover, as in other fields of minimally invasive surgery, conversion should not be considered a defeat for the surgeon, but only a different way to complete the operation.

In conclusion, this study demonstrates the operative feasibility and safety of VAT also in the case of PTC. The results seem to be comparable with those obtained when conventional surgery is used in terms of completeness of the surgical resection, as demonstrated by postoperative serum thyroglobulin measurements, ultrasound scan, and RAIU. Despite the good results obtained in the management more advanced tumors, at least at the moment, VAT should be reserved for small PTCs (T1 to small T2) without any preoperative evidence of lymph node involvement. Thus, it could represent an option for the treatment of small PTCs, especially in young women (low-risk patients) for whom the cosmetic result of the procedure plays an important role. However, for definitive conclusions about the oncologic validity of VAT, longer follow-up evaluation, larger series, and comparative studies are necessary.

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