



# Minimally invasive video-assisted parathyroidectomy (MIVAP) without intraoperative PTH determination

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## Abstract

**Background** Minimally invasive video-assisted parathyroidectomy (MIVAP) has become a standard approach to primary hyperparathyroidism (pHPT) since described. Although intraoperative parathyroid hormone assay (IOPTH) has been generalized as a complementary technique to MIVAP, its actual impact on the surgical success of this technique is not without controversy. The aim of this study was to describe our results in the management of pHPT with successful preoperative localization, by MIVAP technique, without IOPTH determination, confirming in a larger series our preliminary results.

**Methods** A retrospective descriptive study was conducted in pHPT patients treated by MIVAP with no IOPTH determination in a tertiary hospital between 2007 and 2019.

**Results** A total of 167 patients were included in the study. Biochemical cure was achieved in 96.4%, and 94.1% did not present any surgical complication. The mean duration of surgery was 61 min, and the mean length of hospital stay was 1.8 days

**Conclusions** In case of positive preoperative localization studies, MIVAP is a safe and effective technique for the surgical treatment of pHPT due to a parathyroid adenoma, regardless of IOPTH determination, with a success rate > 95% and a low complication rate.

**Keywords** Primary hyperparathyroidism · PTH · MIVAP · IOPTH

## Introduction

Primary hyperparathyroidism (pHPT) is the resultant condition of an inadequate and excessive secretion of parathyroid hormone (PTH) by parathyroid glandular tissue; solitary parathyroid adenoma accounts for 80–90% of all pHPT cases [1].

The diagnosis of this condition is biochemical. Surgery represents the mainstay of treatment [1–3]. It is indicated in all symptomatic cases and in those asymptomatic ones that

meet the criteria proposed in 2014 by the National Institutes of Health (NIH) [4].

Traditionally, bilateral neck exploration has been the standard of care for pHPT, with a cure rate > 95% and < 3% of morbidity [5]. Through the evolution of the imaging and preoperative location techniques, particularly the ultrasonography (US), sestamibi scintigraphy with technetium (<sup>99m</sup>Tc), computed tomography (CT) and single photon emission computed tomography (SPECT), high preoperative localization rates have been achieved (> 95%) [6, 7]. This location improvement, combined with the known fact that solitary parathyroid adenoma is the underlying cause of almost 90% of all pHPT cases, has made minimally invasive parathyroidectomy the primary surgical approach in most patients [5, 8–10].

Ever since it was first described in 1998 by Paolo Miccoli [11], minimally invasive video-assisted parathyroidectomy (MIVAP) has become the standard approach in many centers when a successful preoperative localization has been achieved, with cure rates similar to classic open approaches (95%), better aesthetic results, less surgery and

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hospitalization times, less postoperative pain and reduction of the postoperative morbidity rates [12].

Intraoperative parathyroid hormone assay (IOPTH) has been generalized as a complementary technique to minimally invasive parathyroidectomy to help confirm the proper removal of the hyperfunctional tissue [10, 13, 14]. Although this technique, theoretically, provides certainty regarding the removal of the hyperfunctional tissue, its actual impact on the surgical success of a technique with a curation rate as high as this is not without controversy [15–17].

We have previously described a high curation rate (97%) in a preliminary series of patients with pHPT and positive preoperative localization studies treated by MIVAP without IOPTH determination [18], suggesting that MIVAP may be successfully performed without IOPTH in these cases. The aim of this study was to confirm in a larger series of patients our preliminary results.

## Patients and method

A retrospective descriptive study was conducted in pHPT patients treated by MIVAP in a tertiary hospital between 2007 and 2019. The study was approved by the Institutional Ethics Committee of the Hospital Universitario Central de Asturias, and informed consent was obtained from the patients. All patients had been previously diagnosed by their endocrinologist and referred for surgical treatment after meeting the NIH inclusion criteria [4].

There were considered as candidates for MIVAP those patients with a preoperative localization of the affected gland and that did not exhibit any of the contraindications described to perform a minimally invasive approach to the parathyroid glands: previous cervical surgery or irradiation, concomitant thyroid pathology, family history of multiple endocrine neoplasia syndrome (MEN), as well as in cases of suspected multiglandular disease or parathyroid carcinoma [11].

We analyzed age, sex, presentation symptoms, the location of the enlarged gland, biochemical data prior and after the intervention, the operative time, the characteristics of the adenoma (weight in grams (g) and size in centimeters (cm)), postoperative complications and the length of hospital stay after surgery.

The preoperative localization tests used were single photon emission computed tomography (SPECT-CT) with technetium-99 sestamibi ( $^{99m}\text{Tc}$ ), cervical CT and/or neck ultrasound. No specific criteria were used when indicating these tests, individually or combined, for these patients, leaving the choice to the endocrinologist responsible for the patient.

The surgical technique used was an adaptation of that described by Miccoli et al. [11]. This method requires 2 assistant surgeons in addition to the main surgeon: one in

charge of maintaining tissue retraction and the other one who controls the endoscopy. Briefly, a 1.5-cm transverse incision located 2 cm above the sternal notch is made. Then, a vertical dissection of the midline of approximately 4 cm upwards and downwards is performed, with separation of the infrahyoid musculature ipsilateral to the adenoma. A retractor is used to medialize the ipsilateral thyroid lobe, and the endoscope is introduced. The exploration is addressed to the gland identified as pathological by the preoperative studies. The recurrent laryngeal nerve and the inferior thyroid artery are identified by blunt dissection prior to any vascular ligation. Once identified, the affected gland is removed (Fig. 1).

All patients were followed up, and the PTH and calcium levels were measured at 1 month, 3 months, 6 months and annually, in order to confirm the cure of the pHPT. The surgical success or biochemical cure was defined as the normalization of PTH and calcium values 6 months after surgery.

## Results

The clinical features and surgical results of the patients studied are summarized in Table 1. A total of 167 patients were included in the study, mostly women (84%), with an average age of 68 years (range 23–86 years). All patients had a biochemical diagnosis compatible with pHPT. In most patients (59%), the diagnosis was an accidental finding, and they did not present symptoms. In symptomatic patients, the most frequent initial manifestation was the presence of nephrolithiasis and renal colics (19%), followed by joint pain (14%) and asthenia (5%).

In all cases, a satisfactory preoperative location of the possible adenoma was obtained. In 58% of the cases, more than one imaging technique was used, usually ultrasound and SPECT-CT. The most frequent preoperative location of the involved gland was the lower right (47%).

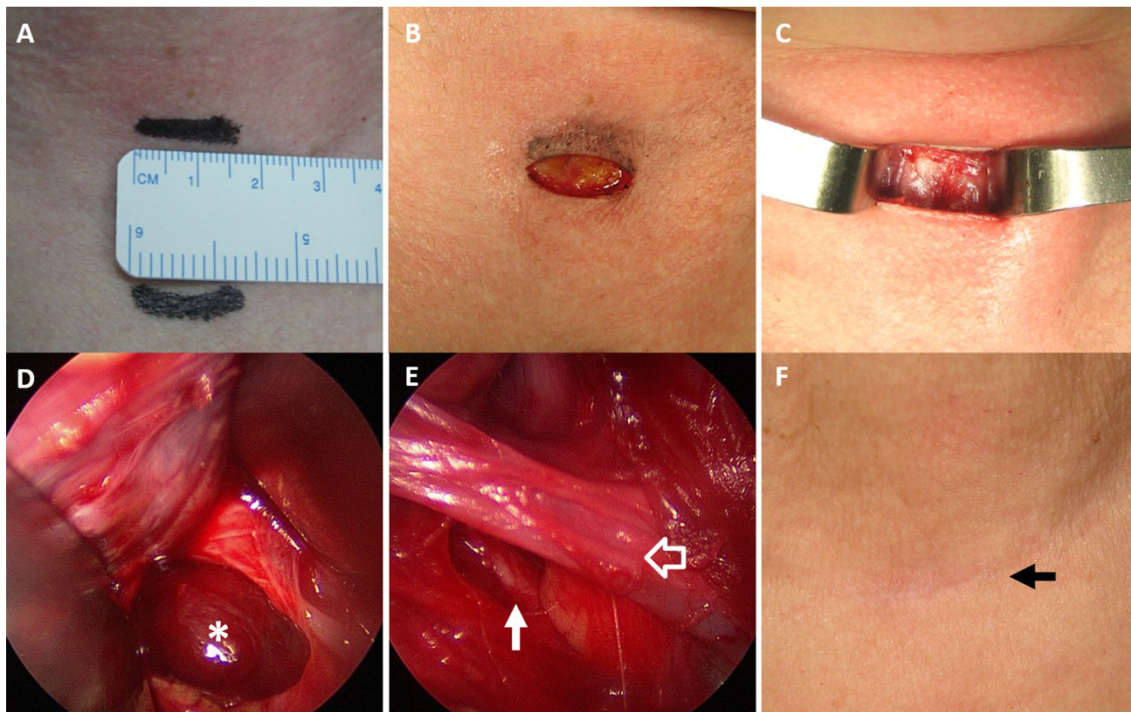
Regarding the biochemical findings, the mean preoperative calcium levels, adjusted based on the albumin, were  $11.3 \text{ mg/dL} \pm \text{SD } 0.97$  (range 9.4–15.6 mg/dL) and the mean PTH value was  $236.1 \text{ pg/mL}$  (range 55–3826 pg/mL).

The mean duration of surgery was 61 min (range 15–150 min). It was necessary to convert MIVAP to an open technique in 5 cases (3%) due to the absence of identification of the suspected enlarged gland in 3 of the cases and to anatomical difficulties in 2 of them.

The mean size of the adenoma was 1.7 cm in larger diameter (range 0.4–4 cm), with a mean weight of 1.2 g (range 0.1–10.3 g).

After surgery, biochemical cure was achieved in 161/167 of the patients (96.4%). For the remaining cases, normalization was obtained after a second surgery, except for one patient, who decided not to undergo the procedure due to its significant cardiovascular comorbidity. In these five cases,





**Fig. 1** Surgical steps of the minimally invasive video-assisted parathyroidectomy. 1.5-cm skin incision about 2 cm above the sternal notch (**a**, **b**); midline dissection and exposition of the thyroid gland (**c**); retraction of the thyroid lobe in the side of the suspected adenoma

and identification of the involved gland (\*) with the help of a 30° endoscope (**d**); endoscopic view of the inferior thyroid artery (large arrow) and recurrent laryngeal nerve (small arrow) after resection of the adenoma (**e**); cervical scar 3 months after surgery (arrow) (**f**)

the cause of persistence of the pHPT was a second adenoma. Of the total patients, 157 (94.1%) did not present any complications. The most frequent postsurgical complication was a temporary paralysis of the vocal cords (all of them recovered during the follow-up) in 6 patients (3.6%). The mean length of hospital stay was 1.8 days (range 1–7 days), after excluding the extreme data of those patients with a hungry bone syndrome, who required 2 weeks of intravenous calcium treatment and 2 patients who suffered decompensation of their underlying heart failure condition.

## Discussion

pHPT is a pathological condition that affects approximately 1% of the population [1]. The only curative treatment is the surgical removal of the hyperfunctioning parathyroid tissue and, given the good results and limited morbidity, it is currently offered to all patients. It is also a cost-effective treatment when life expectancy is greater than 5 years [19].

Minimally invasive techniques can be performed conventionally (with a smaller incision and not searching for the 4 glands), endoscopically (through trocars and gas insufflation) or video assisted (MIVAP) [8, 11]. All the patients in our series were operated following the MIVAP technique, as

described by Miccoli et al. [11], but we did not perform the IOPTH determination to confirm removal of the functioning adenoma. The biochemical cure rate observed after the intervention was > 96%. These results are similar to those described in the bibliography, which generally reflects biochemical cure rates higher than 95% [8, 12], similar to the results obtained with open techniques [9, 10].

The intraoperative determination of PTH is a method that helps to confirm the elimination of the hyperfunctioning parathyroid tissue, which is initially described as part of the MIVAP technique. A recent meta-analysis demonstrated significantly higher cure rates for patients operated with minimally invasive techniques when IOPTH determination was used: Patients in the group treated with IOPTH had a cure rate of 98%, while those treated without IOPTH had a cure rate of 94.8% [20]. The authors of this meta-analysis suggest that minimally invasive parathyroidectomy should be performed only when IOPTH is available. However, despite the results of this meta-analysis, and given the good results obtained without the use of IOPTH, the value of this determination remains controversial. First, there is still controversy about which criteria to apply to define surgical success. Barczynski et al. analyzed the Halle, Miami, Rome and Vienna IOPTH Criteria, and they reported limitations in each one, being the Miami criterion (a decline in IOPTH

**Table 1** Clinical features and surgical results

Parameter	Number (%)
Gender	
Male	26 (16)
Female	141 (84)
Debut symptom	
Asymptomatic	98 (59)
Nephrolithiasis and colic	31 (19)
Joint pain	24 (14)
Asthenia	8 (5)
Neurologic impairment	2 (1)
Vomits	1 (0.5)
Location study	
Ultrasound	7 (4)
SPECT-CT	47 (28)
Computed tomography	16 (10)
Combination	97 (58)
Open technique conversion	
No	162 (97)
Yes	5 (3)
Biochemical curation	
First surgery	161 (96)
Second surgery	5 (99)
Postoperative complications	
None	157 (94)
Vocal cord transient paresis	6 (3.6)
“Hungry bone” syndrome	1 (0.5)
Severe hypocalcemia	1 (0.5)
Surgical wound infection	1 (0.5)

≥ 50% at 10 min after excision) the one that shows the best sensibility and specificity [21]. Another issue is that several studies have shown that IOPTH modifies the attitude in a limited percentage of cases, while increasing the surgical time and the cost of the intervention. Najafian et al. [16] reported that this determination modified the surgical management in < 3% of the surgeries, with higher costs and surgical time. Similar results reported Zawawi et al., with more than 99% of the patients who did not benefit from this determination and with an increase in the average surgical time by 31 min [22]. However, in the above-mentioned meta-analysis, the mean difference in the length of the surgery was only 21.6 min, which was not significant [20]. Morris et al. [23] demonstrated that the increase in cure rates with the use of IOPTH was marginal, although this determination increased the total cost of the intervention by approximately 4%.

We performed a preliminary study of the results of MIVAP without the use of IOPTH in cases with positive preoperative localization studies. We obtained a rate of curative results similar to those described by authors who do use

it (97%) [18], which suggested that IOPTH is not providing additional benefit when the patient fulfils the requirements for MIVAP. In this larger study, the cure rates remain almost identical (96.4%), supporting our policy. Since the mean length of the intervention was 61 min and the mean time for IOPTH is 30 min, this intraoperative determination would therefore increase the duration of the surgery by 50% with associated increased costs. Given the surgical success rate in our series and the minimal margin for improvement with this determination, we do not consider it to be cost-effective, except in selected cases, such as cases without preoperative localization, suspected multiglandular disease and in case of reoperations.

The MIVAP technique is not associated with a higher risk of complications than conventional bilateral cervical exploration or other minimally invasive techniques, mainly due to the excellent visualization of the surgical field and anatomical structures, as well as for allowing the surgeon's touch [12, 24]. In our series, no patient had long-term complications, although about 6% had complications in the immediate postoperative period. Even though 6 patients had temporary vocal cord paresis, no patient had permanent paralysis, in similar manner to other studies that describe recurrent paralysis in less than 1% of cases [12, 24]. The incidence of other complications was testimonial.

## Conclusion

In case of positive preoperative localization studies, MIVAP is a safe and effective technique for the surgical treatment of pHPT due to a parathyroid adenoma, regardless of IOPTH determination, with a success rate > 95% and a low complication rate.

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**Availability of data and material** Authors declare that all data and materials are available for review.

**Code availability** Statistical analyses were performed using IBM SPSS statistics software version 22 for macOS.

## Declarations

**Conflict of interest** The authors have no relevant financial or non-financial interests to disclose.

**Ethics approval** This study was performed in line with the principles of the Declaration of Helsinki.

**Informed consent** Informed consent was obtained from patients who participated in this study.



**Consent for publication** Publication consent was obtained from the patients who participated in this study.

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