

# The Place of Preoperative Imaging Scans In Parathyroid Surgery

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## ABSTRACT

Aim of this study was to evaluate early postoperative results of patients operated for hyperparathyroidism.

Demographics, underlying diseases, preoperative localization scans and efficacy of surgical techniques applied were evaluated in patients with hyperparathyroidism, operated by one surgeon between 2014 and 2017.

Mean age of total 14 patients was 56.6 (range, 22-73). The success rate of ultrasonography applied in all patients (USG, 100 %) was 71.4%. Scintigraphy was done in all patients (100%); localization was wrong in two (14.2%) and false negative ratio was 28.5 % (n=4). Computed tomography and magnetic resonance were used in 17.2 and 28.5%, respectively. Mean preoperative serum calcium level of 11.9 mg/dL (range, 10.6-18.2) was normalized to 8.8 mg/dL (range, 7.1-10.1) in a follow-up of 26 months (range, 6-44). The most common involvements were right lower (n=6, %50) and left lower glands (n=4, %33). Most important surgical indications were adenoma (n=12, 85.7%) and tertiary hyperparathyroidism in kidney transplant patients (n=2, 14.2%). Histopathology revealed adenoma diameter as 1.4 cm (range, 0.5-4). There was no permanent morbidity.

Although the importance of noninvasive localization studies for effective surgical treatment of hyperparathyroidism is generally accepted, bilateral neck dissection and intraoperative exploration seem sine qua non.

**Key Words:** Hyperparathyroidism, surgery, adenoma, renal transplant, imaging studies, neck exploration

## Introduction

Hyperparathyroidism is a disease characterized by abnormally high levels of serum parathyroid hormone (PTH) due to excessive activity of parathyroid glands. Mostly parathyroid adenomas, sometimes multiple adenomas or very rarely parathyroid carcinomas may result in primary hyperparathyroidism, and it presents as high serum PTH and calcium (Ca) levels. In advanced cases, symptoms such as bone pains, gastric ulcers or nephrocalcinosis could be seen. On the other hand, high serum PTH and low Ca levels seen in diseases like malabsorption, vitamin D deficiency or renal failure are the features of secondary (reactive) hyperparathyroidism. In case of persistent secondary hyperparathyroidism and high levels of PTH in the serum, Ca levels will start to rise and result in tertiary hyperparathyroidism.

The primary treatment method is surgery for all symptomatic patients. On the other hand, one of the criteria such as an asymptomatic patient below 50 year-old, a serum Ca level 1 mg/dL above the upper limit of normal, a decrease in bone mineral density,

nephrocalcinosis or increase in urinary Ca extraction, might be an indication for operative approach (1,2). Preoperative imaging scans are usually planned to localize the primary lesion, and employed for all patients who are candidates for surgery. While the success rate of ultrasound (US), one of the most commonly used methods in localization of solitary parathyroid adenomas, has been reported to be between 70 and 90% in the English-written literature; these rates fall below 50% in cases with hyperplasia and double adenomas (3). Besides, scintigraphy with Tc99m sestamibi scan might show different results depending on the ratios of chief and oxyphil cells existing in the adenoma (4). Currently, magnetic resonance imaging (MRI) and computed tomography (CT) studies are seen to be employed more commonly, in addition to above-mentioned classical localization methods.

In the present study, we evaluated the early postoperative results of our patients operated for hyperparathyroidism and aimed to discuss the place of preoperative imaging studies in localization of the primary lesions.

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## Materials and Methods

Our research protocol was approved by our institution's Ethics Committee (B.10.1.TKH.4.34.H.GP.0.01/134). Demographics, underlying diseases, preoperative localization scans and the efficacy of surgical techniques applied were evaluated in patients with hyperparathyroidism, operated by one surgeon between May 2014 and June 2017. The accompanying diseases, histopathological evaluations, postoperative complications and biochemical parameters were investigated, as well.

A standard transverse cervical incision 2 cm above the sternal notch and just below cricoid cartilage was used to explore all parathyroid glands in all patients, and the results of preoperative localization studies were correlated with intraoperative findings. Frozen section study was done in all cases before the closure of incision. Intraoperative hormone evaluation method could not be employed because of the absence of emergent PTH assay kits.

## Results

The mean age of total 14 patients operated by our one endocrine surgeon was 56.6 (range, 22-73 years). Nine patients were women (64.2 %) and five were men (35.7 %). Thyroid and/or neck US was applied in all patients (100 %), and preoperative fine needle aspiration biopsy (FNAB) was performed in cases with thyroid nodules (n=3, 21.4 %). The success rate of US in localization of the primary lesion was 71.4%. Scintigraphy was also done in all patients (100%). The localization was wrong in two cases (14.2%), and false negative ratio was calculated as 28.5 % (n=4). Neck CT and MRI were used in 17.2 and 28.5 %, respectively.

Mean preoperative serum Ca level of 11.9 mg/dL (range, 10.6-18.2) was normalized to 8.8 mg/dL (range, 7.1-10.1) in a follow-up of 26 months (range, 6-44). Most important surgical indications were adenoma (n=12, 85.7%) and tertiary hyperparathyroidism in kidney transplant patients (n=2, 14.2 %), of which 3.5 parathyroidectomy was applied in one and 4 parathyroidectomy plus antecubital auto-transplantation was done in the second patient. The most common involvements in patients with adenoma were right lower (n=6, 50 %) and left lower glands (n=4, 33 %). Right and left upper glands were involved less commonly (n=1, 8.3 %, per each). There was no multiple adenomas in our series. Histopathological studies revealed the diameter of adenoma as 1.4 cm (range, 0.5-4).

Hypertension (57.1%), diabetes (42.8%) and thyroid disease (28.5%) were the most common accompanying diseases. Unilateral (n=2) and bilateral (n=1) thyroidectomies were added in cases with thyroid nodules meeting operative indications.

There was no mortality and permanent morbidity such as persistent hyperparathyroidism, recurrence and permanent hypoparathyroidism. One patient had transient unilateral vocal cord paralysis and two had hematoma.

## Discussion

The efficacy of preoperative localization studies in the surgical treatment of hyperparathyroidism is still under discussion. More rapid and reliable surgery has been proven to be possible in case of combined applications of imaging scans and/or their use of one by one (3). However, the mini-invasive open unilateral or videoscopic surgical techniques are clearly dependent upon the correctness of preoperative localization studies. This situation is not valid for the cases in whom standard neck exploration has been applied. The results of our series can be given as an example to the mentioned second approach, as well.

The traditional imaging methods in localization studies of hyperparathyroidism are US and scintigraphy. However, in cases of nonconclusive scan results, negative findings and/or recurrent disease, supplementary imaging methods like CT and MRI are seen to be come into current clinical applications. Preoperative US localization study has been reported to be successful in 70 to 90% of solitary adenomas, which is responsible for most of the parathyroid lesions (3). Ruda et al. (5) reported that the sensitivity of US in localization of solitary adenoma, hyperplasia and double adenoma in primary hyperparathyroidism as 79, 35 and 16%, respectively. In another study reported by Siperstein et al. (6), combined use of preoperative US study and intraoperative PTH assay has resulted in good surgical outcomes in 75% of prospectively followed-up 350 patients. The authors also stated that the success rate might increase to over 90 % in case of bilateral surgical exploration had been applied in the same patient group. Other than these studies, there are reports stating that 88 to 95 % success rate could be possible in combination of standard US application and color Doppler study showing the polar artery in the parathyroid adenoma (7, 8).

Currently, scintigraphy with Tc99m sestamibi scan has been reported to show different results depending on the ratios of chief and oxyphil cells existing in the adenoma. Mihai et al. (4) showed 32% negative result

in their study performed on 158 patients with hyperparathyroidism. They suggested that the negativity reaches its highest levels in adenomas with predominant chief cells.

In our study, all patients had US and scintigraphy as standard preoperative localization study and the success rate of US in detecting parathyroid lesion was estimated to be 71.4 %. In our series, the wrong localization and false negative results of scintigraphy were 14.4 and 28.5 %, respectively. These results seem to be compatible with the English-written literature. However, in our opinion, more expert US radiologists involved in the team work and the addition of colored Doppler in selected cases will absolutely increase the success rate of preoperative localization studies.

In nonconclusive imaging scan results, negative findings, recurrent disease or ectopic foci, traditional methods may not be sufficient. In these complicated cases, supplementary imaging methods like CT and MRI are currently used progressively in all over the world (3). As shown in our series operated by one experienced endocrine surgeon in limited period of the present study, bilateral surgical exploration demonstrating all four glands without considering whether the lesion is adenoma or hyperplasia brings out more than 95% success rate. Intraoperative frozen sections and emergent PTH assays will absolutely result in the best results. In our study, CT and MR were used in less than one third of the patients with inconclusive standard localization scans. Furthermore, the only intraoperative correction method was frozen section. However, four gland exploration used as the standard surgical method resulted in 100% success, without permanent postoperative complications.

In conclusion, the most effective treatment of hyperparathyroidism is surgery, and four gland exploration technique is still more reliable approach

to parathyroid lesions, especially in difficult cases with inconclusive preoperative localization studies.

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