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Importance of Parathyroid Hormone Needle Aspiration Washout in Adenoma Localization in Primary Hyperparathyroidism

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Data Collection B
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Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEF G 1 **Zafer Pekkolay**
DFG 2 **Şadiye Altun Tuzcu**

1 Department of Adult Endocrinology, School of Medicine, Dicle University, Sur, Diyarbakır, Turkey

2 Department of Nuclear Medicine, Gazi Yaşargil Training and Research Hospital, Yenışehir, Diyarbakır, Turkey

Corresponding Author: Zafer Pekkolay, e-mail: drpekkolay@gmail.com

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Background: Primary hyperparathyroidism is an endocrine disease characterized by excessive secretion of parathyroid hormone and hypercalcemia. Although scintigraphy is commonly used for pre-operative localization, it does not always localize the parathyroid lesion. In such patients, ultrasonography can visualize the suspected lesion and needle washout sample for parathyroid hormone titer can be used to confirm parathyroid tissue. The aim of this study was to investigate the accuracy of the parathyroid hormone needle aspiration washout method in detecting the localization of parathyroid adenoma.





Material/Methods: Patients with primary hyperparathyroidism who underwent surgery between 2010 and 2017 at the Dicle University Medical Faculty Hospital were retrospectively evaluated using medical records. Patients undergoing parathyroid hormone needle aspiration washout were performed in the suspected lesion were included in the study. Accompanied by ultrasonography, the suspected area was penetrated with needle, and negative aspiration was performed. Pre-operative scintigraphic data of patients were evaluated. Patients with positive scintigraphy, negative scintigraphy or patients who did not undergo scintigraphy were included in our study. Demographic data were presented as continuous data means \pm standard deviation. Categorical variables were presented as frequency and percentage.

Results: Forty-nine patients (female/male, 40/9) who underwent parathyroid hormone needle aspiration washout were included in the study. Parathyroid hormone washout result was positive in 47 patients (47/49) and negative in 2 patients (2/49), sensitivity/positive predictive value (PPV) 95.91%. Twenty-six patients who had negative/suspicious scintigraphic results were diagnosed using the parathyroid hormone needle aspiration washout method (24/26, 92.3% accuracy). Parathyroid hormone needle aspiration washout without scintigraphy was performed in 13 patients (13/13, 100% accuracy).

Conclusions: Parathyroid adenoma localization can be easily done using parathyroid hormone needle aspiration washout in centers experienced in adenoma localization in primary hyperparathyroidism cases in which scintigraphic results are negative or scintigraphy cannot be performed. We believe that primary parathyroid hormone needle aspiration washout can be a new localization method for adenoma localization.

MeSH Keywords: **Biopsy, Fine-Needle • Hyperparathyroidism, Primary • Parathyroid Neoplasms**

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Background

Primary hyperparathyroidism is a prevalent endocrine disease characterized by hypercalcemia with elevated or inappropriately normal level of parathyroid hormone. It is usually caused by a single adenoma, and cases caused by multiple gland hyperplasia are less prevalent [1]. Multiple adenomas and cancer are rare [2]. The definitive treatment for primary hyperparathyroidism is surgery [3]. Scintigraphy and ultrasonography are usually used for localization prior to surgery [4]. Ultrasonography is an effective, cost-effective, and easily applicable method used to perform parathyroid hormone needle aspiration washout with no radiation risk. Four parathyroid glands are located in the thyroid gland posterior. Parathyroid adenoma based on ultrasonography may frequently be of hypoechoic characteristic related to thyroid parenchyma and rarely have anechoic cyst. Doppler shows peripheral vascularity and asymmetric blood build-up pattern inside adenoma [5,6]. Magnetic resonance imaging and 4-dimensional computed tomography are used when scintigraphy and ultrasonography do not show parathyroid adenoma [7]. These methods sometimes do not localize the parathyroid lesion [8]. Parathyroid hormone needle aspiration washout has been recently used for adenoma localization [9]. The aim of this study was to investigate the accuracy of the parathormone needle aspiration washout method in detecting the localization of parathyroid adenoma.

Material and Methods

Study design

This study was performed retrospectively in patients who had surgery for primary hyperparathyroidism who applied to Dicle

University Endocrinology Department between 2010 and 2017. Approval for the use of the data was obtained from the local ethics committee (Dicle University 102/2018). The study was conducted following the guidelines of the Declaration of Helsinki. Informed consent was obtained from all patients for data use.

Patients undergoing parathormone needle aspiration washout were included in the study. Patients with positive scintigraphy, negative scintigraphy and patients who did not undergo scintigraphy were included in our study.

Patients who did not undergo parathormone needle aspiration washout, were <18 years of age, pregnant women, and patients with chronic renal failure were excluded from the study.

Parathyroid hormone needle aspiration washout method

Accompanied by ultrasonography, the suspected area was penetrated with a 10-mL/22-gauge needle, and negative aspiration was performed. After removal, the needle was rinsed with 1 mL 0.09% NaCl. Parathyroid hormone in the washing liquid was examined (Figure 1).

Data of patients who underwent parathyroid hormone needle aspiration washout were recorded. Patients were regarded as positive if their parathyroid hormone needle aspiration washout results were higher than that in their serum (in Mayo clinic data, patients with parathyroid hormone needle aspiration washout value of ≥ 1000 pg/mL or aspirate levels above the serum level were considered positive) [10]. Intraoperative parathyroid hormone levels of all patients were examined after the removal of the adenoma. Sensitivity of the parathyroid hormone needle aspiration washout procedure was tested.

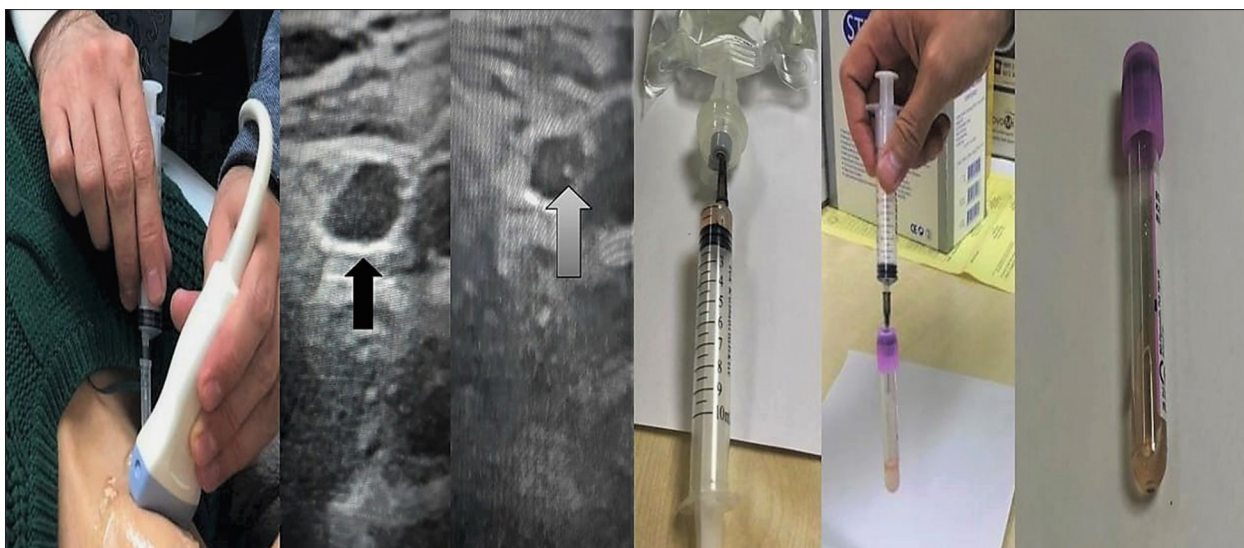


Figure 1. Washout procedure. Black arrow: parathyroid adenoma; white arrow: needle in parathyroid adenoma.

Parathyroid hormone needle aspiration washout positivity and pathology results of the patients were compared.

Scintigraphic results were positive, negative, suspicious, as well as results for those who did not have scintigraphic procedures due to radiation risk were included in the study. Those with positive scintigraphy results were excluded from the study. Scintigraphic results images were reviewed using the electronic digital imaging by independent radiology experts.

Ultrasonography was performed by a senior specialist endocrinologist. To reduce the risk of surgical failure, a parathormone needle aspiration washout was performed on the suspected localization of parathyroid adenoma. Needle washes were performed on the suspicious area with guide of ultrasonography.

Laboratory parameters

The level of parathyroid hormone was measured by electrochemiluminescence method using Roche-cobas 6001. The normal parathyroid hormone values of our laboratory are 15–65 pg/mL. Pre-operative scintigraphic results and parathyroid hormone, calcium, phosphorus, and albumin levels of all patients were recorded.

SPSS 22 (Inc., Chicago, IL, USA) was used to analyze statistical data. Demographic data were presented as continuous data means \pm standard deviation. Categorical variables were presented as frequency and percentage. Shapiro-Wilk and Kolmogorov-Smirnov tests were used for normal distribution. Values that did not conform to normal distribution are presented as median and minimum-maximum. The paired simple test was used to compare preop and postop calcium and parathormone levels.

Results

Forty-nine patients (female/male ratio was 40/9) who underwent parathyroid hormone needle aspiration washout were included in the study. The average age was 49.25 ± 15.67 years (range, 18–81 years). Pre-operative parathyroid hormone and calcium levels were 238.00 pg/mL (range, 68–1725 pg/mL) and 11.65 ± 1.39 mg/dL (range, 9.0–16.3 mg/dL) respectively. Postoperative parathyroid hormone and calcium levels were 29.40 pg/mL (range, 3–115 pg/mL), and 8.82 ± 0.93 mg/dL (range, 7.3–11.6 mg/dL) respectively. The median parathyroid hormone needle aspiration washout value was 1534.50 pg/mL (range, 11–5000 pg/mL). Parathyroid hormone needle aspiration washout results were positive in 47 patients (47/49) and negative in the remaining 2 patients (2/49) (sensitivity/accuracy ratio: 95.91%). Pathology results of all patients with positive and negative parathyroid hormone needle aspiration

washout values were consistent with those of adenoma. There were 26 patients with negative or indefinite scintigraphic results (24/26, 92.3% accuracy). Parathyroid hormone needle aspiration washout was performed in 10 patients, although scintigraphic results were positive, and their value was positive in all these patients. Parathyroid hormone needle aspiration washout was performed in 13 patients without scintigraphy (13/13, 100% accuracy). The pathology results of these patients were consistent with those of adenoma (Table 1).

Discussion

In this study, we have shown that when pre-operative localization studies do not indicate adenoma in primary hyperparathyroidism, localization can be easily detected with parathyroid hormone needle aspiration washout using ultrasonography. Moreover, we revealed that primary parathyroid hormone needle aspiration washout can be conducted for localization before the operation.

Correct adenoma localization in primary hyperparathyroidism increases surgical success. Currently, there is no method that can precisely locate adenoma.

Scintigraphy is usually used as the first step for pre-operative localization in primary hyperparathyroidism. The accuracy of scintigraphy in localization is 54–96% [11]. Scintigraphy can also give false-positive results, and this risk increases especially in the presence of a thyroid nodule [12]. In the meta-analysis carried out by Moghadam et al., the sensitivity of parathyroid scintigraphy was 84% [13]. In a study by Akbaba et al., the success rate of parathyroid scintigraphy in showing localization was 67% [14]. In our study, localization accuracy rate of scintigraphy was 67%.

Currently, minimally invasive surgery is preferred in the surgical treatment of primary hyperparathyroidism. Factors that increase the success rate of minimally invasive surgery are correct pre-operative localization and surgeon's experience. Minimally invasive surgery has more advantages than bilateral exploration in terms of treatment cost, hospitalization time, complication risks, and cure. Accurate localization of adenoma before the operation is of great importance and ensures the feasibility of the minimally invasive surgery [15–17]. In our study, 63% of patients underwent minimally invasive surgery.

Parathyroid hormone needle aspiration washout has recently been used for the detection of adenoma localization. In a study by Cansu et al., parathyroid hormone needle aspiration washout was performed in 22 primary hyperparathyroidism patients with negative scintigraphic results. Parathyroid hormone needle aspiration washout and cytology results were

Table 1. Patient characteristics.

Patient characteristics		
Number of patients	49	
• Female	40 (82%)	
• Male	9 (18%)	
Average age (years)	49.25±15.67 (18–81)	
Preop		
• Parathyroid hormone (pg/mL) (median)	238.00 (68–1725)	
• Calcium(mg/dL)	11.65±1.39 (9.0–16.3)	
Postop		
• Parathyroid hormone (pg/mL)(median)	29.40 (3–115)	
• Calcium(mg/dL)	8.82±0.93 (7.3–11.6)	
Parathyroid hormone washout (pg/mL) (median)	1534.50 (11–5000)	
Paired simple test		
• Pre-op versus post-op parathormone	P<0.01	
• Pre-op versus post-op calcium	P<0.01	
Scintigraphy	Parathormone washout	
• Positive	10	10/10 (100%)
• Negative or indefinite	26	24/26 (92.3%)
• Not carried out	13	13/13 (100%)
Parathyroid hormone washout		
• Number of patients		49
• Positive		47
• Negative		2
• Sensitivity		95.91%
Positive predictive value (PPV)		95.91%

compared, and parathyroid hormone needle aspiration washout was found to be superior for adenoma localization [18].

Abdelghani et al. demonstrated that parathyroid hormone needle aspiration washout showed adenoma localization in 24 patients with recurrent primary hyperparathyroidism [19].

Kuzu et al. demonstrated that parathyroid needle washing under the guidance of ultrasonography before the operation increased the success rate of the operation even when intra-operative parathyroid hormone test was not conducted [20].

In a retrospective analysis by the Mayo Clinic, parathyroid hormone needle aspiration washout was performed in 67 patients and sensitivity was 84%, whereas specificity and positive predictive value was 100%. False-negative results were obtained in a small number of patients [10].

In our study, parathyroid hormone needle aspiration washout was performed in 49 patients for adenoma localization with 96% accuracy. The presence of adenoma was proven with pathologic assessment. As an innovative contribution to the literature, adenoma localization was performed with primary

parathyroid hormone needle aspiration washout without scintigraphy in 13 patients.

Parathyroid hormone needle aspiration washout might cause tumor spread in parathyroid carcinomas. In our series consisting of 151 patients, there was no pathologically proven parathyroid carcinoma. Parathyroid hormone needle aspiration washout and minimally invasive surgery is not recommended in cases of suspected parathyroid carcinoma due to very high calcium levels, very high parathyroid hormone levels, and findings of invasion in clinic examination or imaging [21].

There were some limitations to our study, such as the retrospective nature of the study and the low number of patients who had washout procedures performed. Because of the lack of appropriate needles in our clinic, the thick needle we used in the study was of a nature that could damage the parathyroid tissue. We recommend a parathormone washout with thinner needles.

Conclusions

Parathyroid hormone needle aspiration washout is a highly accurate method that can be used to detect parathyroid adenoma in patients with negative or indefinite scintigraphic results. The probability of definite localization in patients who undergo parathyroid hormone needle aspiration washout is high, making minimally invasive surgery an easier option.

Parathyroid hormone needle aspiration washout has the potential to become a primary method in parathyroid adenoma localization in select patients.

Conflict of interest

None.

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