

Comparison of Imaging Methods in Parathyroid Gland Enlargement

F. M. Velibeyoglu, M. R. Altiparmak, N. Seyahi, K. Serdengeçti and E. Ereğ

Division of Nephrology, Department of Internal Medicine, Cerrahpaşa Medical Faculty, İstanbul University, Turkey

Abstract

Background. We conducted a cross-sectional study to investigate the imaging procedures used to detect parathyroid gland enlargement and to compare the agreement of different imaging modalities.

Methods. We examined the medical records of chronic hemodialysis (HD) patients enrolled in six outpatients HD centers in İstanbul. Patients with a parathyroid imaging in the last 12 months were analyzed. Clinical, biochemical and radiological data were collected from patient files. Parathyroid gland enlargement was defined according to the result of any of the following examination; ultrasound (USG), computerized tomography (CT), magnetic resonance imaging (MRI) and scintigraphy.

Results. 524 (276 M, 248 F; mean age 48.5 ± 15.9) patients were included to the study. Mean PTH level was 556 ± 473 pg/ml. Parathyroid gland enlargement was associated with high PTH and ALP levels. USG, CT, MRI and scintigraphy were performed in 313, 72, 8, 262 patients respectively (in 106 patients more than one examination was performed). Parathyroid gland enlargement was found in 17.9% of the patients. Ultrasound showed a good agreement with computerized tomography and scintigraphy.

Conclusions. Due to its diagnostic value and cost advantage, ultrasound examination should be the first choice for the detection of parathyroid gland enlargements

Key words: hemodialysis, parathyroid gland, imaging methods.

Introduction

Bone mineral metabolism abnormalities were detected even in the very early stages of chronic renal diseases (1). These abnormalities eventually cause to renal osteodystrophy. Renal osteodystrophy is a general term that is used to describe a large spectrum of bone diseases ranging from adynamic bone diseases to osteitis fibrosa (2, 3). Hyperparathyroidism is a usual laboratory finding in patients with osteitis fibrosa (2). Enlarged parathyroid glands can be visualized with nuclear scintigraphy, ultrasound examination (USG), magnetic resonance imaging (MRI) or computerized tomography (CT). In this study we examined parathyroid gland imaging finding in chronic hemodialysis patients. We evaluated the agreement between commonly used imaging modalities for parathyroid imaging.

Patients and Methods

We examined medical records of chronic hemodialysis (HD) patients, who were on regular hemodialysis therapy in six different centers located in İstanbul. All patients were on regular hemodialysis therapy at least for 3 months. Medical records for the last 12 months were examined in every patient; and 524 patients who have a parathyroid gland imaging were included in this study. Parathyroid gland enlargement was defined according to the result of any of the following examination: USG, CT, MRI or scintigraphy. All scintigraphy examinations were performed using ^{99m}Tc -Sestamibi. Patients were accepted as having parathyroid gland enlargement if parathyroid gland enlargement was detected by any one of the above mentioned imaging modalities.

Demographic and clinical data were collected from patient's records. According to local regulations complete blood count and biochemical analysis must be performed monthly in every chronic HD patients and PTH levels must be checked in every 3 months. We recorded the last available laboratory parameters (PTH, ALP, calcium, phosphorus, ferritin, hematocrit) from patient files. History of parathyroidectomy during the last 12 months was also recorded from patients' files.

Data was expressed as mean \pm standard deviation (SD). Statistical calculations were performed using SPSS 10.0 software (SPSS for windows, SPSS inc. IL, USA). Categorical variables were compared using chi-square test, and parametric variables were compared using Student's t-test. The agreement between two different imaging modalities for the detection of parathyroid gland enlargement was examined using kappa statistic. $P < 0.05$ was considered as significant.

Results

The mean age of the 524 patients was 48.5 ± 15.9 years, 276 (52.7%) of them were male and 248 (47.3%) were female (Table 1). The cause of end stage renal disease was diabetes mellitus in 88 (16.8%), chronic glomerulonephritis in 89 (17.0%), hypertensive nephrosclerosis in 72 (13.7%), chronic interstitial nephritis in 24 (4.6%), polycystic kidney disease in 17 (3.2%), miscellaneous causes in 30 (5.7%) and unknown in 204 (38.9%) patients. The mean duration of HD was 64.2 ± 52.1 months (median 48 months, range [7-302 months]). Hemodialysis was performed 3 times/week in 474 (90.5%) patients, twice weekly in 46 (8.8%) patients and once a week in 4 (0.8%) patients.

Laboratory parameters of the patients are listed in Table 1. The mean PTH level was 556 ± 473 pg/ml (median: 443 pg/ml, range: [8- 2657 pg/ml]). Parathyroid gland enlargement was detected in 94 (17.9%) patients. Patients with parathyroid gland enlargement had higher PTH and ALP

levels compared to patients without parathyroid gland enlargement (Table 1). The numbers of patients, parathyroid gland imaging modality, the frequency of parathyroid gland enlargement, the frequency of previous parathyroidectomy in different PTH levels is shown in Table 2.

Table 1. Clinical and laboratory data of patients

	All patients (n=524)	PGE (+) patients (n=94)	PGE (-) patients (n=430)	P
Sex (Male, %)	52.7	56.3	51.2	0.49
Age (years)	48.5 ± 15.9	46.0 ± 14.6	49.1 ± 16.2	0.09
Duration of HD (months)	64.2 ± 52.1	70.2 ± 54.9	62.9 ± 51.5	0.22
Parathyroidectomy (%)	4.0	7.4	3.2	0.078
PTH (pg/ml)	556 ± 473	785.4 ± 608.5	506.0 ± 422.9	<0.001
Calcium (mg/dl)	9.0 ± 1.0	8.98 ± 1.05	9.03 ± 1.03	0.69
Phosphorus (mg/dl)	5.2 ± 1.4	5.22 ± 1.47	5.23 ± 1.44	0.94
ALP	409.0 ± 378.0	609.36 ± 538.7	365.1 ± 316.9	<0.001
Ferritine	788.8 ± 883.6	933.5 ± 1203.2	755.8 ± 792.5	0.18
Hematocrite (%)	32.2 ± 5.2	32.7 ± 5.6	32.1 ± 5.2	0.26

Note: Values are expressed as mean \pm SD, unless otherwise indicated.

PGE: parathyroid gland enlargement, HD: hemodialysis, PTH: parathyroid hormone.

Table 2. Parathyroid imaging modalities and parathyroid gland enlargement in different PTH levels

PTH level (pg/ml)	0-150 (n=106)	151-300 (n=82)	301-800 (n=213)	>800 (n=123)	Total (524)
PGE (n, %)	20 (18.8)	8 (9.7)	21 (9.8)	45 (36.5)	94 (17.9)
Parathyroidectomy (n, %)	4 (3.8)	1 (1.2)	9 (4.2)	7 (5.7)	21 (4.0)
Ultrasound (n, %)	14 (13.2)	4 (4.8)	171 (80.2)	123 (100)	312 (59.5)
Computerised tomography (n, %)	7 (6.6)	5 (6.1)	34 (16.0)	26 (21)	72 (13.7)
Magnetic resonanace (n, %)	3 (2.8)	2 (2.4)	0 (0)	3 (2.4)	8 (1.5)
Sintigraphy (n, %)	87 (82.0)	74 (90.0)	64 (30.0)	37 (30.1)	262 (50.0)

PGE: parathyroid gland enlargement

According to the results of imaging tests parathyroid gland enlargement was detected in 94 (17.9%) patients. Patients with parathyroid gland enlargement had higher PTH and ALP levels, compared to patients without parathyroid gland enlargement (Table 1). The numbers of patients, parathyroid gland imaging modality, the frequency of parathyroid gland enlargement, and the frequency of previous parathyroidectomy in different PTH levels are shown in Table 2. We also compared patients who had a parathyroidectomy with patients who did not have a parathyroidectomy. Patients with previous parathyroidectomy had a longer duration of hemodialysis (141.1 ± 64.9 months vs 73.8 ± 63.8 months, $P < 0.001$) and higher phosphorus levels (6.0 ± 1.3 vs 5.2 ± 1.4 , $P = 0.01$), the remaining study parameters were not statistically different between the two groups (data not shown).

USG was the most frequently used modality followed by scintigraphy (Table 2). A single imaging modality was performed in 418 patients, two imaging modality was performed in 91 patients and three different imaging modality was performed in 15 patients.

Table 3. Agreement between ultrasound examination and scintigraphy for parathyroid gland enlargement

		Sintigraphy		
		PGE (-)	PGE (+)	Total
Ultrasound	PGE (-)	31	5	36
	PGE (+)	2	25	27
	Total	33	30	63

Table 4. Agreement between ultrasound examination and computerized tomography for parathyroid gland enlargement

		Computerised tomography		
		PGE (-)	PGE (+)	Total
Ultrasound	PGE (-)	51	0	51
	PGE (+)	0	10	10
	Total	51	10	61

Both USG and scintigraphy were performed in 63 patients (Table 3). The agreement for the presence of parathyroid enlargement was good between USG and scintigraphy (kappa 0.78, $P < 0.001$). Both USG and CT were performed in 61 patients (Table 4). The agreement for the presence of parathyroid enlargement was very good between USG and CT (kappa 1, $P < 0.001$).

Discussion

PTH level is a useful marker for the evaluation of renal osteodystrophy. According to Kidney/Dialysis Outcome Quality Initiative-K/DOQI guidelines, target level for PTH is between 150-300 pg/ml (4). The frequency of parathyroid gland enlargement is positively correlated with the level of PTH (5).

To the best of knowledge data on the frequency of parathyroid gland enlargement in chronic hemodialysis patients is sparse (6). According to our data the prevalence of parathyroid gland enlargements was 17.9%. However, we want to point out that we only examined patients who had a parathyroid imaging in the last 12 months. It is natural that a considerable number of patients with low or normal PTH

levels did not have any parathyroid imaging. Because of this selection bias an overestimation of the real frequency of parathyroid gland enlargements is expected.

In line with previous studies in our study the prevalence of parathyroid gland enlargement was highest in patients with PTH level >800 ng/dl. Interestingly, parathyroid gland enlargement was detected in a substantial number of patients with low PTH levels (0-150 pg/ml). A parathyroidectomy operation performed after the imaging procedure or aggressive therapy of hyperparathyroidism can be possible explanations of this finding. Unfortunately because of the cross-sectional nature of our study we can not definitely explain this data.

According to some authors, scintigraphy is the most sensitive method for the detection of parathyroid gland enlargement in hemodialysis patients (7). In our study ultrasound examination showed a good agreement with CT and scintigraphy, for the detection of parathyroid gland enlargement. Cost of the imaging procedures is also an important concern. According to current regulations in governmental hospitals in Turkey the price of parathyroid imaging (including the initial examination by the medical doctor) is 17.2 US\$, 55.5 US\$, 64.9 US\$, 71.2 US\$ (1 US\$= 1.35 YTL) for USG, CT, MRI and scintigraphy respectively (8). Prices in private hospitals are more expensive. Ultrasound examination is non-invasive and less costly compared to other imaging procedures.

In conclusion, we examined a fairly large number of hemodialysis patients who had a parathyroid imaging procedure in the last 12 months; the frequency of parathyroid gland enlargement was 17.9%. USG is inexpensive, non-invasive and showed good agreement with other imaging procedures. Therefore we think that USG can be accepted as

the first imaging procedure to reveal parathyroid gland enlargement in chronic hemodialysis patients.

References

1. Hossain RM, Rahman H, Rashid HU, et al. Biochemical and imaging alterations of renal bone disease in newly detected predialysis and on maintenance dialysis patients. *Hemodial Int* 2005; 9: 21-24.
2. Yudd M, Llach F. Uremic osteodystrophy. *Dialysis Therapy* 3rd edition. Nissenson AR, Fine RN (eds). *Hanley & Belfus, Philadelphia*, 2002; 383-410.
3. Sherrard DJ, Hercz G, et al. The spectrum of bone disease in end-stage renal failure: An evolving disorder. *Kidney Int* 1993; 43: 436-442.
4. National Kidney Foundation. K/DOQI clinical practice guidelines for bone metabolism and disease in chronic kidney disease. *Am J Kidney Dis* 2003; 42: 1-201.
5. Gladziwa U, Ittel TH, et al. Secondary hyperparathyroidism and sonographic evaluation of parathyroid gland hyperplasia in dialysis patients. *Clin Nephrol* 1992; 38: 162-166.
6. Salem MM. Hyperparathyroidism in the hemodialysis population: A survey of 612 patients. *Am J Kidney Dis* 1997; 29: 862-865.
7. Fukagawa M, Kitaoka M, Tominaga Y, Kurukawa K. *Imaging and Intervention of Parathyroid Hyperplasia. The Spectrum of Renal Osteodystrophy* 2nd edition. Drüeke B.T., Salusky I. Oxford University Press, 2002; 421-439.
8. <http://www.bumko.gov.tr/Mevzuat/ButceM> (seen in 8-5-2007).