

Double-Phase

Tc-99m Sestamibi

Comparison Study of Lesion Localization in Patients with Primary and Secondary Hyperparathyroidism using Double-Phase Tc-99m Sestamibi Scintigraphy

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Abstract

Purpose: The purpose of this study was to evaluate and compare the scintigraphic findings and diagnostic accuracy of double-phase Tc-99m sestamibi scan in primary and secondary hyperparathyroidism (HPT).
Materials and Methods: We retrospectively reviewed 16 cases of primary (18 lesions) and 11 cases of secondary HPT (44 lesions) who underwent Tc-99m-sestamibi scan before the surgical intervention. Scan was performed using LEM camera (Siemens, Germany) after the injection of 740MBq of Tc-99m sestamibi. Routine image consisted of baseline and 3-hour delayed images and each image was obtained using both parallel and pinhole collimator. The study population was 27 patients (male/female=5/22, age: 49.1 ± 10.8).
Results: Eighteen lesions of primary HPT consisted of 13 adenomas and 5 hyperplasias, while all lesions of secondary HPT were hyperplasias. Among the cases of primary HPT, we could detect all the lesions (13 adenomas) but only 2 lesions of 5 hyperplasias (40%) could be detected by double phase scintigraphy. Three cases of primary lesion showed decreased uptake in delayed images compared with baseline. The sensitivity, specificity, positive predictive value and accuracy of primary and secondary HPT were 58.8% (10/17), 83.3% (10/12), 83.3% (10/12), 75.9% (22/29), and 37.5% (15/40), 50% (2/4), 88.2% (15/17), 38.6% (17/44), respectively. Overall sensitivity, specificity, positive predictive value and accuracy were 43.9% (25/57), 75% (12/16), 86.2% (25/29), and 53.4% (39/73). There were no statistical differences between the weights of primary and secondary HPT lesions ($p > 0.05$).
Conclusion: Tc-99m sestamibi scan is a fairly good modality to detect parathyroid lesions in patients with primary HPT before the surgical intervention. However, since some cases may reveal decreased uptake in delayed images, a careful attention to the findings in baseline images may be helpful. Still, the low accuracy of sestamibi scan in the diagnosis of secondary HPT prohibits routine use of it for this disease. (**Korean J Nucl Med 1999;33:368-80**)

Key Words: Tc-99m sestamibi, Primary hyperparathyroidism, Secondary hyperparathyroidism, Parathyroid glands

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 18 11 44 4.
 Tc-99m sestamibi Tc-99m sestamibi
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 (M:F=5:22). 25
 68 52.9
 29 65 45 2
 intact parathyroid hormone (iPTH), 가
 2. 0, 가 0.5, 가
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 H&E
 Tc-99m sestamibi
 3. Tc-99m sestamibi 가
 (low energy 가
 high resolution parallel collimator) 가
 (pin hole collimator) 가
 (LEM, Siemens, Hoffman Estates, IL)
 0.3 0.4 ml 가 740 MBq (20
 mCi) Tc-99m sestamibi (Cardiolite[®], Dupont
 Merk Pharmaceutical Co., Billerica, MA)
 (bolus IV injection) 95%
 가
 low energy general purpose
 (LEGP)
 (AP)
 가 (30
) (3)
 iPTH 92.15 pg/ml(10 65 pg/ml) 가
 10.5 mg/dL (8.8 11 mg/dL), 3.4

mg/dL (2.5 - 4.5 mg/dL)

iPTH, 678.5 pg/ml, 8.31 mg/dL, 3.84 mg/dL

iPTH 가

가 (Fig. 4).

Table 1

4 1

7

4 가

9 , 4 , 3 ,

1 (Table 2). 0.1 g 4.3 g

0.5 3 g 1.49 g 1.09 g

13 unpaired *t*-test

5 . 5 p-value 0.628

16 가 가 7 1

18 3 (Fig. 5). 가

2 가 8 가

(Fig. 1). 1 2

Table 3

(Fig. 2).

(contrast) Tc-99m sestamibi

가 (Fig. 3) 7 2 Table 4

가 1 wash out 76.5% (13/17),

가 64.7% (11/17)

가 3

Fig. 1. (A) A 51 year-old female patient with parathyroid adenoma (case# 3) shows focal increased uptake in upper portion of right thyroid gland area (baseline). (B) Only a minimal focal uptake remains in same area due to relatively rapid wash out of radioisotope (delayed image).

Fig. 2. (A) A 49 year-old female patient with primary hyperparathyroidism (case# 5) shows no definite focal hot uptake in the baseline study. (B) Delayed image reveals questionable faint uptake in left lower portion of thyroid gland. (C) Imaging after the additional injection of isotope demonstrate mild focal uptake in same area.

Fig. 3. (A) A 55 year-old female patient with primary hyperparathyroidism (case# 6) shows focal dense hot uptake in right lower portion (baseline). (B) Persistent uptake in this lesion and rapid wash out of thyroid uptake result in increased contrast (delayed image).

Fig. 4. (A) A 68 year-old male patient with ectopic parathyroid lesion (case#15) shows focal hot uptake in upper mediastinum area (baseline). (B) A focal uptake in this area become more discrete and thyroid uptake was markedly decreased (delayed image).

Fig. 5. (A) A 29 year-old female patient with chronic renal disease (case# 6) shows two focal hot uptake in both lower portion of thyroid gland (baseline). (B) Persistent uptake is noted in these lesions and another focal lesion is suspected in just upper portion of hot uptake in right lower area (delayed image).

5 2
 (Table 1).
 58.8% (10/17) . 13 가 37.5%
 (15/40), 가 40% (16/40)
 3 가 37.5%
 가 (15/40) .

Table 1. Result of Tc-99m sestamibi scan and Pathology in Primary Hyperparathyroidism

No.	Sex/Age	Location of lesion*	iPTH (pg/ml)	Ca/P (mg/dL)	Pathology	Weight (gm)	Baseline MIBI scan †	Delayed MIBI scan †
1	F/62	RU	199.27	12.7/2.3	N	0.1	0	0
		RL			N	0.1	0	0
		LU			H	2.5	0	0
		LL			N	0.1	0	0
2	F/51	LU	16.51	12.3/2.1	H	3.0	0	0
		LL			H	1.2	1	1
3	F/51	RU	83.15	12/2.4	A	1.0	1	0
4	F/36	RU	9.38	11.8/2	N	0.2	0	0
		RL			A	2.8	1	2
5	F/49	RU	19.08	8.5/3.3	N	0.1	0	0
		RL			N	0.1	0	0
		LU			N	0.1	0	0
		LL			A	0.5	0	0.5
6	F/55	RL	11.26	8.2/2.5	A	1.2	1	2
7	F/56	LL	157.33	9.4/3.5	H	0.8	1	0.5
		RL			N	0.1	0	0
8	F/59	RU	4.77	9.4/4.8	N	0.1	0	0
		RL			N	0.1	0	0
		LU			A	1.5	1	0
		LL			N	0.1	0	1
9	F/55	LU	121.79	15.3/8.14	A	0.8	2	2
		LL			N	0.5	2	2
10	F/61	LL	286.97	8.4/5.46	H	0.6	0	0
11	F/25	LL	(-)	(-)	A	1.0	1	2
12	F/62	LL	13	2/1.54	A	1.8	1	2
13	F/51	LL	(-)	(-)	A	2.0	1	2
14	F/66	LL	(-)	(-)	A	0.9	1	0
15	F/68	Ectopic	(-)	(-)	A	0.8	1	2
16	F/40	RU/RL	183.3	16.1/2.5	A	3.0	1	2

* RU, right upper; RL, right lower; LS, left upper; LI, left lower; RU/RL, right upper to lower.

† Tc-99m sestamibi uptake degree (0: same uptake as thyroid; 0.5: faint uptake compared with thyroid uptake 1; between 0.5 and 2; 2: prominent hot uptake) (-) unable to check; iPTH, intact parathyroid hormone; A parathyroid adenoma; H, parathyroid hyperplasia; N, normal parathyroid.

83.3% (10/12) 가
 83.3% (10/12) 가
 가 49.19% (28/57), 가 50% 가
 47.37% (27/57) 가 가
 43.9% (25/57) .
 91.67% (11/12), 81.3% (13/16), 83.3% (12/16)

Table 2. Result of Tc-99m Sestamibi Scan and Pathology in Secondary Hyperparathyroidism

No.	Sex/Age	Location of lesion*	iPTH (pg/ml)	Ca/P (mg/dL)	Pathology	Weight (gm)	Baseline MIBI scan †	Delayed MIBI scan †
1	F/56	RU	(-)	(-)	H	0.8	0	0
		RL			H	1.5	2	2
		LU			H	0.4	0	0
		LL			H	1.0	0	1
2	F/57	RU	(-)	(-)	N	0.5	1	2
		RL			H	0.5	1	1
		LU			H	0.6	0	0.5
		LL			H	1.0	0	0
3	M/65	RU	10.24	7.5/3.6	H	1	0	0
		RL			H	2.3	0.5	1
		LU			H	1.1	0	0
		LL			H	2.5	1	2
4	F/35	RU	2.41	7.6/3.5	H	4.3	1	2
		RL			H	3.8	1	0.5
		LU			H	1.2	1	2
		LL			H	1	1	0
5	F/54	RU	269.22	11.3/4.8	H	0.9	0	0
		RL			N	0.3	0	0
		LU			H	0.6	0	0
		LL			H	1.6	1	1
6	F/29	RU	26.36	6.9/2.7	N	0.1	0	0
		RL			H	2.8	1	2
		LU			H	0.2	0	0
		LL			H	0.9	1	2
7	F/46	RU	986.13	10.5/3.3	H	0.5	0	0
		RL			H	0.5	0	0
		LU			H	0.5	0	0
		LL			H	0.6	0	0
8	F/29	RU	1000.0	7.6/1.3	H	0.5	0	0
		RL			H	0.5	0	0
		LU			H	1.0	0	0
		LL			H	1.0	0	0
9	F/40	RU	1550	5.6/4.2	H	0.4	0	0
		RL			H	1.5	0	0
		LU			H	0.4	0	0
		LL			H	1.0	0	0
10	M/40	RU	1590.9	10.7/6.5	H	3.0	2	2
		RL			H	1.2	2	2
		LU			H	1.5	2	2
		LL			N	0.8	2	2
11	M/42	RU	670.8	7.1/5.0	H	0.5	0	0
		RL			H	0.5	0	0

LU	H	0.5	0	0
LL	H	1.0	2	2

* RU, right upper; RL, right lower; LS, left upper; LI, left lower.

† Tc-99m sestamibi uptake degree (0: same uptake as thyroid; 0.5: faint uptake comparing with thyroid uptake; 1: between 0.5 and 2; 2: prominent hot uptake) (-), unable to check; iPTH, intact parathyroid hormone H, parathyroid hyperplasia; N, normal parathyroid.

Table 3. The Comparison of Tc-99m Sestamibi Uptake Degree in Baseline and Delayed Images of Primary and Secondary Hyperparathyroidism with Pathologic Result

Baseline image	Delayed image			
	grade 0	grade 0.5	grade 1	grade 2
Grade 0				
1'HPT	12 (N:10, H:2)	0	1 (A:1)	1 (H:1)
2'HPT	25 (N:2, H:23)	1 (H:1)	1 (H:1)	0
Grade 0.5				
1'HPT	0	0	0	0
2'HPT	0	0	1 (H:1)	0
Grade 1				
1'HPT	2 (A:2)	1 (H:1)	2 (H:2)	7 (A:7)
2'HPT	1 (H:1)	1 (H:1)	2 (H:2)	6 (N:1, H:5)
Grade 2				
1'HPT	0	0	0	2 (A:2)
2'HPT	0	0	0	6 (H:6)

Grade 0, no detectable focal uptake; Grade 0.5, faint uptake; Grade 1, between Grade 0.5-2; Grade 2 prominent hot uptakes more than thyroid bed; 1'HPT, primary hyperparathyroidism; 2'HPT, secondary hyperparathyroidism; N, normal parathyroid; H, parathyroid hyperplasia; A, parathyroid adenoma.

가 75% (12/16) CT
80%

(Table 4).

Table 4 Tc-99m sestamibi 가 .16)

75.9% (22/29), 가
38.6% (17/44) 가 가

53.4% (39/73)

. Taillefer 7)

Tc-99m- sestamibi double-phase 21
19 (90%)

Double-phase Tc-99m-sestamibi 가 Billotey
Tl-201/Tc-99m 17) 55%, 64.5%

Table 4. Sensitivity, Specificity and Positive Predictive Value and Accuracy of Tc-99m Sestamibi Scan for Localization of Primary and Secondary Parathyroidism

	Baseline scan*	Delay scan*	Baseline/delay scan †
Sensitivity			
Primary HPT	76.5% (13/17)	64.7% (11/17)	58.8% (10/17)
Secondary HPT	37.5% (15/40)	40% (16/40)	37.5% (15/40)
Overall	49.2% (28/57)	47.4% (27/57)	43.9% (25/57)
Specificity			
Primary HPT	91.7% (11/12)	83.3% (10/12)	83.3% (10/12)
Secondary HPT	50% (2/4)	50% (2/4)	50% (2/4)
Overall	81.3% (13/16)	83.3% (12/16)	75% (12/16)
Positive predictive value			
Primary HPT	92.9% (13/14)	84.6% (11/13)	83.3% (10/12)
Secondary HPT	88.2% (15/17)	88.9% (16/18)	88.2% (15/17)
Overall	90.3% (28/31)	87.1% (27/31)	86.2% (25/29)
Accuracy			
Primary HPT	82.8% (24/29)	72.4% (21/29)	75.9% (22/29)
Secondary HPT	38.6% (17/44)	40.9% (18/44)	38.6% (17/44)
Overall	56.2% (41/73)	53.4% (39/73)	53.4% (39/73)

* Positive criteria were higher Tc-99m sestamibi uptake than thyroid bed.

† Positive criteria were persistent or more increased Tc-99m sestamibi uptake on delay image than baseline image; 1'HPT, primary hyperparathyroidism; 2'HPT, secondary hyperparathyroidism.

	Baseline scan*	Delay scan*	Baseline/delay scan †
Sensitivity			
Primary HPT	76.5% (13/17)	64.7% (11/17)	58.8% (10/17)
Secondary HPT	37.5% (15/40)	40% (16/40)	37.5% (15/40)
Overall	49.2% (28/57)	47.4% (27/57)	43.9% (25/57)
Specificity			
Primary HPT	91.7% (11/12)	83.3% (10/12)	83.3% (10/12)
Secondary HPT	50% (2/4)	50% (2/4)	50% (2/4)
Overall	81.3% (13/16)	83.3% (12/16)	75% (12/16)
Positive predictive value			
Primary HPT	92.9% (13/14)	84.6% (11/13)	83.3% (10/12)
Secondary HPT	88.2% (15/17)	88.9% (16/18)	88.2% (15/17)
Overall	90.3% (28/31)	87.1% (27/31)	86.2% (25/29)
Accuracy			
Primary HPT	82.8% (24/29)	72.4% (21/29)	75.9% (22/29)
Secondary HPT	38.6% (17/44)	40.9% (18/44)	38.6% (17/44)
Overall	56.2% (41/73)	53.4% (39/73)	53.4% (39/73)

* Positive criteria were higher Tc-99m sestamibi uptake than thyroid bed.

† Positive criteria were persistent or more increased Tc-99m sestamibi uptake on delay image than baseline image; 1'HPT, primary hyperparathyroidism; 2'HPT, secondary hyperparathyroidism.

가 가 1

가 8 가 가 9

(nodular hyperplasia) 2

가 Tc-99m sestamibi 가

.12) 가

가

Tc- 99m sestamibi Chesser

Tc-99m sestamibi 가

가 .2)

37.5% 40%

가 37.5% 가

Pons 13) 1997 54% Piga 21)

44%

88.2%

88.9% 88.2%

sestamibi Tc-99m

가

Tc-99m sestamibi

4

가 4

가 가

80% 가

75%

가 가

가 가

가 가

Tc-99m-sestamibi double-phase

14

2 가 16 18

11 44

Tc-99m-sestamibi

Tc-99m-sestamibi double-phase

LEM (Seimens, Germany)

740 MBq

2

3 가

(M:F=5:22) 29 65 49.1

18 13

5

13

5

2 (40%)

3

Double phase 58.8% (10/17)

83.3% (10/12), 83.3% (10/12)

75.9% (22/29)

37.5% (15/40), 50% (2/4),

88.2% (15/17) 38.6% (17/44)

43.9% (25/57), 75% (12/16),

86.2% (25/29) 53.4% (39/73)

(p>0.05). : Tc-99m-sestamibi

가

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