

# 휴식 Tl-201/디피리다몰 부하 Tc-99m-MIBI 심근 관류 SPECT의 예후 예측 성능

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## Prognostic Value of Rest Tl-201/Dipyridamole Stress Tc-99m-MIBI Myocardial Single Photon Emission Computed Tomography(SPECT)

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### ABSTRACT

**Background and Objectives** : Dual isotope myocardial SPECT, rest thallium-201/dipyridamole stress Tc-99m sestamibi is used to diagnose coronary artery disease. We examined predictive value of myocardial SPECT for the prognosis of patients having or suspected coronary artery disease. **Materials and Method** : We examined 692 patients referred for dipyridamole stress myocardial perfusion SPECT. Cardiac events (hard and soft events) were followed up with medical record review and telephone interview. Survival analysis and multivariate Cox proportional hazard model were used to find significant predictors and the incremental predictive value of myocardial SPECT. Patients with coronary angiography (n = 246) were analyzed in separate group. **Results** : There were 4 hard events and 3 soft events in 341 normal SPECT group (1.20%/yr). There were 5 hard events and 21 soft events in 351 abnormal SPECT group (4.69%/yr). Survival curve was separated between normal SPECT group and abnormal SPECT group (p<0.01). In univariate analysis, smoking, history of myocardial infarction, typical chest pain and SPECT findings were important variables. In multivariate analysis, SPECT result was the single most independent predictor. Large reversible perfusion abnormality predicted worse prognosis. In patients with coronary angiography, SPECT did not add statistically significant predictive value to the coronary angiography. **Conclusion** : Dipyridamole stress Tl-201/ MIBI dual isotope myocardial perfusion SPECT provided excellent prognostic information. Extent of reversible perfusion decrease was the independent predictor of future cardiac events. (**Korean Circulation J 1998;28(8):1260-1271**)

**KEY WORDS** : Myocardial perfusion SPECT · Coronary artery disease · Prognosis · Dipyridamole stress

서 론

가 .<sup>1)</sup>  
가

2

: 1998 6 25

: 1998 8 21

: , 110 - 744

28

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30~40%<sup>2)3)</sup>

CT 85%<sup>4)</sup>

SPECT

가 SPECT

1980

TI - 201

가<sup>5)</sup> TI - 201

Tc - 99m - MIBI

가<sup>6)</sup>

가<sup>7)8)</sup>

SPECT가

SPECT

가<sup>9-13)</sup>

SPECT

가<sup>12)</sup>

가<sup>13)</sup>

가<sup>5)</sup>

TI - 201/

MIBI SPECT

Kang<sup>15)</sup>

SPECT 가

## 재료 및 방법

### 대상 환자군의 선정

1994 1 1 1995 12 31

SPECT 1,100

SPECT

1997

8 SPECT

20 가 870

20

1

SPECT

71

87

SPECT 2

1,100

692 (Fig. 1).

### 심근 SPECT 방법

TI - 201

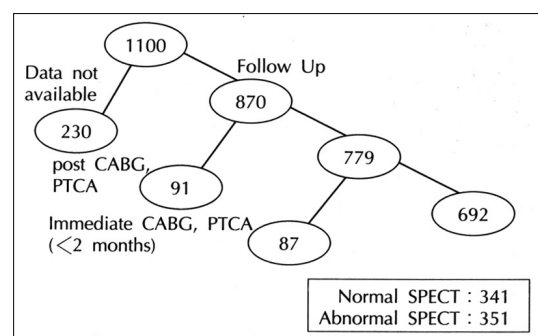
Tc - 99m MIBI

가

48

6

TI -



**Fig. 1.** Study Population. Eighty seven patients in whom CA-BG or PTCA were performed within 2 months after SPECT studies were excluded because SPECT findings were used for the preparation of revascularization.

201 111MBq(3mCi) 5~15 50%

SPECT (PRISM 3000, Picker)

15 4 50%

0.56 mg/kg

가 가 3

370MBq(10 mCi) Tc-99m MIBI

1 경과 추적 관찰

Tc-99m MIBI 3

2 가

24 “ (Hard event)

영상 판독 SPECT 2 “

(Fig. 2). 17 (Soft event)

0 3 (0 : , 1 : (uncensored, complete observation)

, 2 : , 3 : ) 가

, 가 ,

3가 가

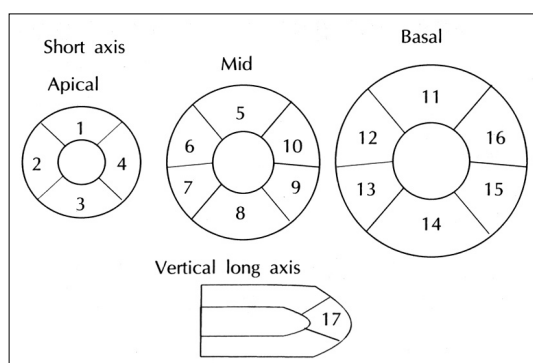
가

관동맥조영술 ECT 2 SP -

692 246 SPE -

Judkin 35 mm CT가

30 SPECT



**Fig. 2.** Assignment of myocardial segments for scoring of perfusion abnormalities on SPECT images. Seventeen segments were scored from 0 (normal) to 3 (defect). Stress scores were summed to represent disease extent in myocardial perfusion SPECT.

(censored cases, incomplete observation)

(termination of the study)

가  
(follow - up loss)

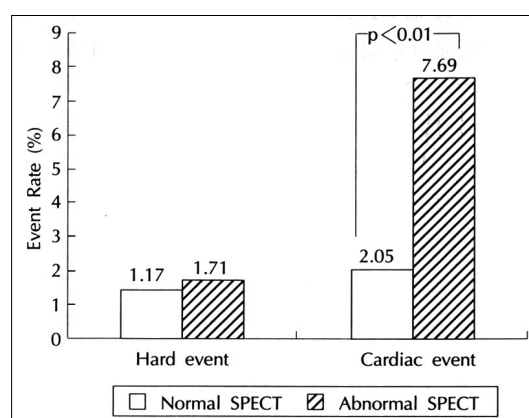
(censoring)

SPECT ,  
 q , (creatinine kin -  
 ase) , SPECT 가  
 SPECT  
 Cox 가  
 (hazard ratio)가  
 50 가  
 140 mmHg, 90 mmHg  
 Cox  
 140 mg/dl SAS for Windows 6.12  
 240 mg/dl  
 SPECT  
 결 과  
 , , , 대상 환자군의 특성  
 692  
 230  
 가 ,<sup>16)</sup> 15% 가  
 , 15% 85% 가 , 85% 58.9 ± 10.3 ( 22  
 가 ~88 ). 388 (56%) 304  
 (44%) . 81 (11.7%)  
 생존분석, Cox 비례위험도 분석과 통계 처리 가  
 SPECT 443 (64%) 168 (24.3%)  
 가 Student t . 51 (7.4%) , 30  
 (4.3%) (non - vascular su -  
 Student t rgery)  
 . SPECT SPECT가  
 SPECT  
 Pearson . p 341 351  
 0.05 SPECT 86.9  
 가 SPECT 85.3  
 (Life table method)  
 Ma -  
 ntel - Haenszel 가 SPECT  
 Cox  
 가 가  
 . Cox (p < 0.01, Table 1).  
 (35 )  
 , , (658 )  
 , ,  
 가 <sup>16)</sup> 가

가  
(censored)  
SPECT 4  
3  
2.05%( : 1.20%/ ) . 1  
가 3  
가 2  
SPECT 6 21  
7.69%

**Table 1.** Patient characteristics of groups having normal and abnormal SPECT findings

	Normal SPECT	Abnormal SPECT	p-value
Number	341	351	
Age	59 ± 11	59 ± 10	0.97
Male	43.7%	68.1%	0.01
Symptoms			
Typical angina	42.8%	84.6%	0.001
Atypical chest pain	39.6%	9.4%	0.001
Asymptomatic	13.2%	1.7%	0.001
Hypertension	43.8%	56.4%	0.001
Diabetes	23.1%	37.1%	0.306
History of acute myocardial infarction	1.2%	21.9%	0.001
Smoking	25.3%	48.6%	0.001
Hypercholesterolemia	186 ± 61	193 ± 59	0.141



**Fig. 3.** Total and hard event rates among the patients showing normal or abnormal SPECT findings. Statistical difference (chi square test,  $p < 0.01$ ) was found in the total event rates, but not in hard event rates.

**Table 2.** Patient characteristics of groups who experienced cardiac events and who did not during follow-up

	Cardiac event (n = 35)	No events (n = 658)	p-value
Age	58.3 ± 9.2	59.0 ± 10.4	0.677
Male Sex, %	64.7%	55.6%	0.401
Symptoms			
Typical Angina	91.4%	62.6%	0.010
Atypical Symptom	8.6%	25.1%	
Asymptomatic		12.3%	
Hypertension	54.3%	50.1%	0.628
Diabetes	20%	25.1%	0.495
History of myocardial infarction	28.6%	10.8%	<0.001
Smoking	60.6%	35.0%	0.003
Serum Cholesterol	194 ± 44	189.5 ± 60.8	0.741
Pretest Likelihood of CAD	78 ± 20.7	61.8 ± 30.0	0.008
Referral rate of coronary angiography	32.7%	88.6%	<0.001
Number of reversible perfusion defect on myocardial SPECT	3.7 ± 3.9	1.1 ± 2.4	<0.001
Number of persistent perfusion defect on myocardial SPECT	1.7 ± 4.0	0.9 ± 2.6	0.06

( : 4.69%/ ) . 3 가  
3  
. 13  
8

SPECT SPECT 가 ( ECT 가 SPECT  
p<0.001, Fig. 3).

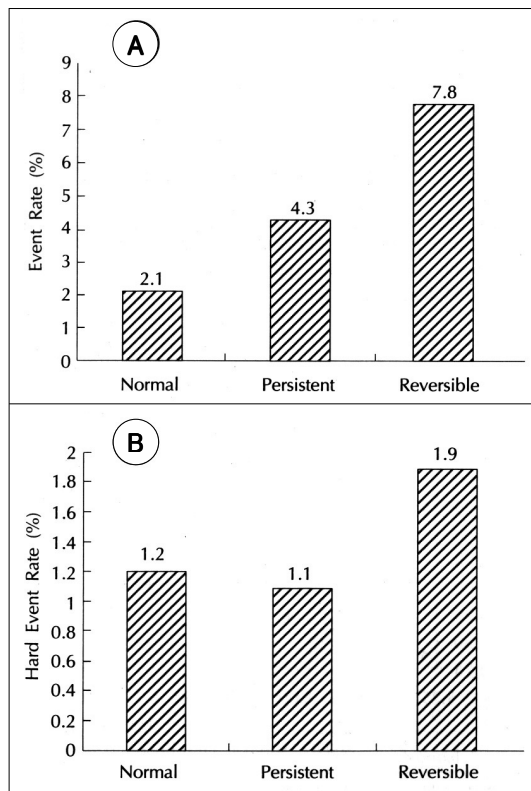
가

(Fig. 4).

(Fig. 5).

가

가 가



**Fig. 4.** Total and hard event rates by SPECT findings. Reversible abnormality included partially reversible perfusion decreases. Total event rate was higher in patients having reversible decrease. A : total event rate, B : hard event rate.

SPECT

(Fig. 6).

심근관류 SPECT결과와 생존 분석

SPECT

가 SP-

ECT

가 SPECT

(p=0.0018, Fig. 7).

Cox 비례위험도 모델의 적용

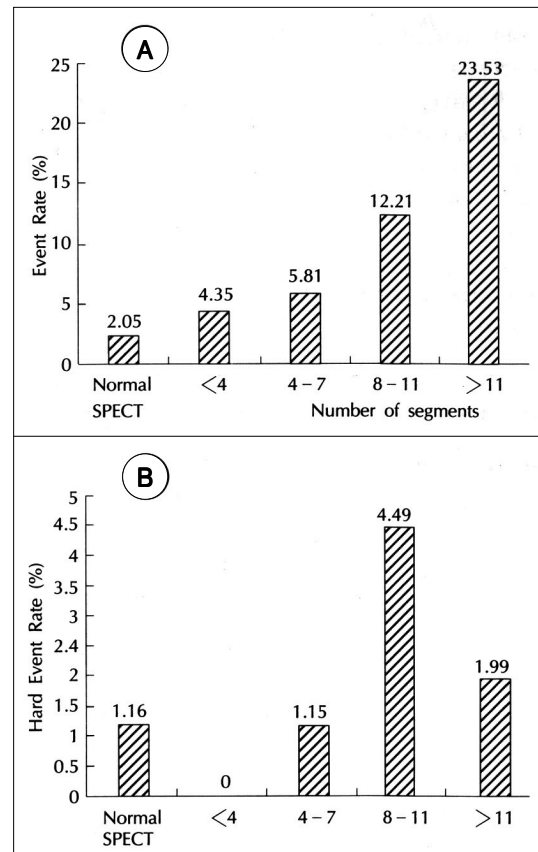
(S(t))

[y=log(-log(S(t)))]

가

Cox

(Fig. 8).



**Fig. 5.** Comparison of event rates by number of segments with decreased perfusion at stress. Summed stress score was grouped normal, patients having less than 4 abnormal segments, more than 4 and less than 7, more than 8 and less than 11, and having more than 11 segments. A : total event rate, B : hard event rate.

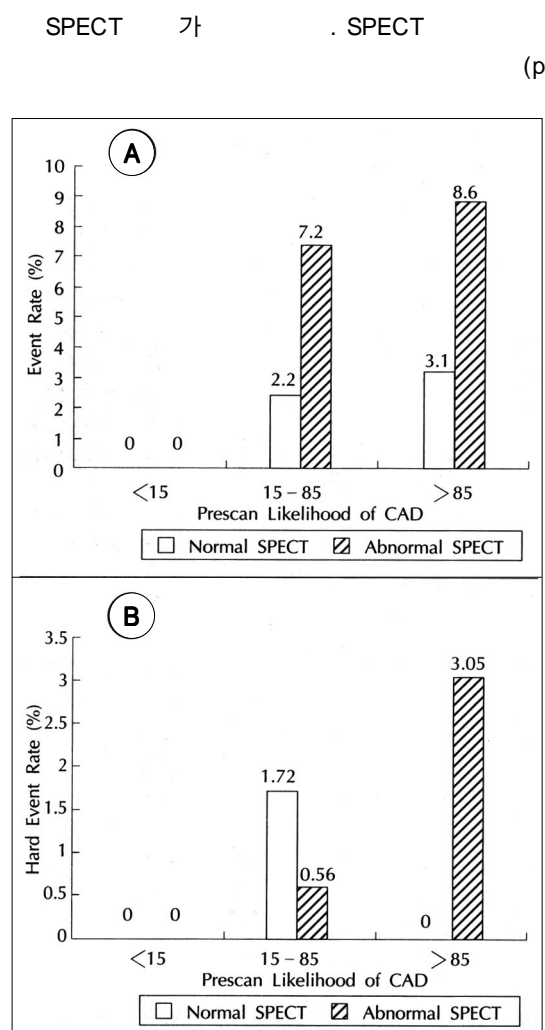
Cox  
p Table 3 A  
SPECT  
가 SPECT  
가  
( )  
Cox  
Table 3 B

=0.0008, 11.2).  
가

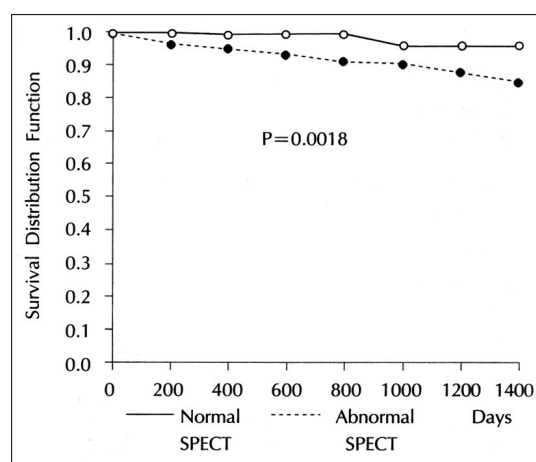
가  
(Table 3).

관동맥조영술을 시행한 환자와 시행하지 않은 환자에서  
예후 비교

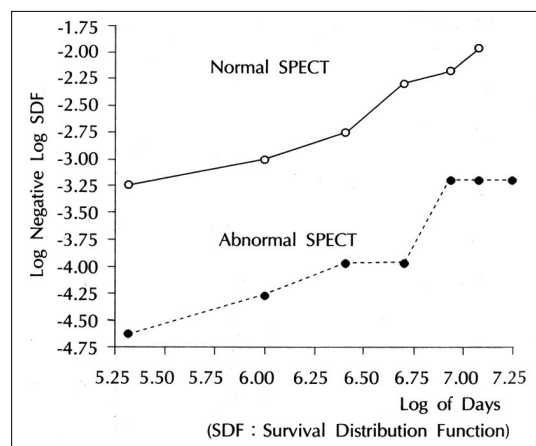
246 SPECT  
, 446



**Fig. 6.** Total and hard event rates according to the pre-test likelihood of coronary artery disease (CAD). Pretest likelihood was calculated using Pryor and colleagues' report<sup>15)</sup>. A : total event rate, B : hard event rate.



**Fig. 7.** Survival curves showing a separation of total cardiac events between the patients with and without perfusion SPECT abnormalities.

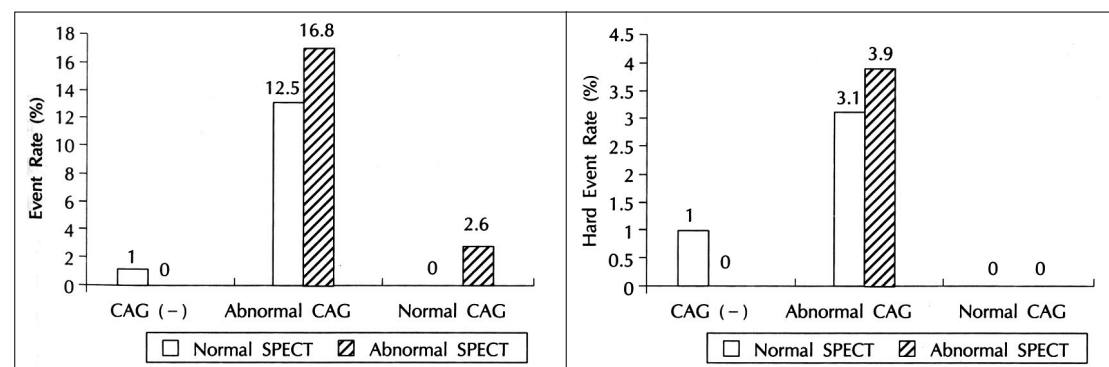


**Fig. 8.** Log-log survival distribution functions of two groups with or without SPECT abnormalities were parallel to each other. Two curves showed no crossing but were increasing as time went by. Basic assumption of time-invariance of proportional hazard ratios was partially fulfilled.

SPECT	341	52	가 39	SPECT	1
	(15.2%), SPECT			2.6%	
351	194			187	SPECT
(55.3%). 246		65		155	
72	50		26		16.8%
	59				
	59	SPECT	SPECT	가	32
가 20	SPECT			12.5%	4
					SPECT가

**Table 3.** Relative risks of variables and their confidence interval. P values were calculated using Cox proportional hazard model.

A. Univariate model				
Variables	Relative risk	95% Confidence interval	P-value	
Age	1.259	0.487 - 3.253	0.6345	
Sex	1.601	0.893 - 2.869	0.1140	
Symptom	2.413	1.209 - 4.818	0.0125	
Hypertension	1.027	0.590 - 1.789	0.9246	
Diabetes	1.306	0.713 - 2.394	0.3873	
History of myocardial infarction	2.407	1.281 - 4.523	0.0064	
Hypercholesterolemia	1.148	0.558 - 2.359	0.1463	
Smoking	1.798	0.993 - 3.256	0.0526	
Pre-test likelihood of coronary artery disease	2.031	1.114 - 3.702	0.0208	
Abnormal SPECT	2.553	1.378 - 4.732	0.0029	
Reversible defect (4 - 7)	2.469	1.170 - 5.208	0.0177	
Reversible defect (> 7)	6.326	2.445 - 16.363	<0.0001	
B. Multivariate model				
Variables	Relative risk	95% Confidence interval	P-value	
Symptom	1.995	0.820 - 4.854	0.1281	
History of MI	1.314	0.644 - 2.682	0.4530	
Smoking	1.321	0.750 - 2.476	0.3856	
Abnormal SPECT	2.802	1.212 - 6.474	0.0159	
Reversible defect (4 - 7)	3.071	1.265 - 7.455	0.0132	
Reversible defect (> 7)	5.667	1.965 - 16.335	0.0013	



**Fig. 9.** Total and hard event rates in patient groups in whom coronary angiography was performed (n = 246) and not (n = 446). Angiographic findings were so important predictors that we could not find incremental value of SPECT findings in patients in whom coronary angiography was performed.



SPECT가 SPECT 가 . SPECT

( $p > 0.05$ ). 5% . SPECT

446 0.5~1% .<sup>9-13)</sup>

SPECT 가 SPECT가

1.2% . SPECT

가

고 찰

SPECT

SPECT 가 .

4)

SPECT 3 (0.7%) 446

SPECT

가

가 SPECT

SPECT

1)3)5)

SPECT

SPECT

SPECT가 4

(12.5%) SPECT

가

16.8%

( $p > 0.05$ ). 가

SPECT

15% SPECT 가 85% SPECT

16)

가 SPECT

SPECT

가

SPECT

(risk stratification)가 가

가

5)9)

SPECT

SPECT 가 가

SPECT

가

SPECT

가

가

가

SPECT

3)9)10)

SPECT가 Iskandrian 가 3)

SPECT가

가

가

SPECT



재료 및 방법 :

가 SPECT  
692 (SPECT  
341 , 351 )  
(  
)  
SPECT 2  
)  
결 과 :  
SPECT 4  
3  
2.05%(1.20%/ )  
SPECT 6 21  
7.69%(4.69%/ )  
( , p<0.01). SPECT  
가 (Mantel -  
Haenszel , p<0.01). Cox  
SPECT  
(p = 0.0008, 11.17). 가  
가 SPECT  
(246 ) SP -  
ECT 가  
결 론 :  
SPECT  
1.20%  
SPECT  
SPECT  
가  
SPECT가  
중심 단어 : SPECT . . .

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