

혈관경련성 협심증 환자에서의 운동부하 유발 검사 : 단계적 부하 검사와 비단계적 부하 검사

김영권 · 신현덕 · 이무용 · 이명용 · 최유식 · 김병하

Exercise Provocation Test in Patients with Vasospastic Angina : Graded vs. Non-Graded Exercise Test

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ABSTRACT

Background and Objectives : In patients with coronary vasospastic angina we investigated whether exercise ECG test results vary with the different modes of exercise load and compared various clinical characteristics, including coronary risk factors, between patients with positive and those with negative exercise test results. **Materials and Methods :** This study examined 34 patients who had documented coronary artery spasm without significant stenosis (coronary artery luminal diameter narrowing <70%). The two different modes of treadmill exercise ECG tests, the first based on the Bruce's protocol (graded exercise test, GET) and the second on the sudden rapid exercise protocol (non-graded exercise test, NGET), were performed in the morning of the same day. **Results :** Of 29 patients who underwent both GET and NGET, 19 patients manifested a positive result by NGET, whereas only 11 did by GET (66 vs. 38%, $p = 0.04$). All patients with a positive GET result produced a positive NGET result and 8 of 18 patients with a negative GET result also did. Of 34 patients who underwent GET, there was no significant difference in the frequency of hypertension, diabetes, current smoking, history of effort chest pain, mixed disease (fixed stenosis >50%, <70% of luminal diameter) or in total cholesterol level between patients with positive and those with negative results. Among 18 patients with typical variant angina by clinical history, 8 of 10 patients with high disease activity (5 or more attacks per week) exhibited a positive result by either GET or NGET, whereas 4 of 8 patients with low disease activity did (80 vs. 50%, $p = \text{NS}$). **Conclusion :** In patients with coronary vasospastic angina, sudden rapid exercise has the potential to induce coronary artery spasm more frequently than multistage exercise. Exercise test results may not be correlated with coronary risk factors, coronary anatomy, effort chest pain, and the disease activity. (Korean Circulation J 2001;31(9):857-866)

KEY WORDS : Vasospastic angina · Treadmill exercise · Provocation test.

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서 론

가 가 ,

가 가 .

¹⁾

대상 및 방법

ergonovine⁴⁾,²⁾³⁾ acetylchol-
ine⁴⁾ ergonovine⁵⁾⁶⁾ 대 상
1995 8 1998 2 1999 9
(hy -
2001 5
perventilation test),⁷⁻¹⁰⁾ (cold pres -
sure test),¹⁰⁻¹²⁾ (cold pres -
sure test),¹⁰⁾¹¹⁾¹³⁻¹⁵⁾ ergonovine
(mental stress test),¹⁰⁾ ergonovine ergo -
¹⁶⁾ novine (total or
subtotal occlusion)가
70%¹⁶⁾ 3
가
¹⁰⁾¹¹⁾ 34 53±
8 (39 70) 가 28 .
(significant fixed stenotic lesion) 가
가 , 18 , 15 , 1
가 , er - 50% , 70%
gonovine 가 가 (, mixed disease) 9
가 가 가 . (Table 1).

방 법

Judkins
ergonovine Han⁶⁾ er -
(bicycle exercise)
(treadmill exercise)¹⁵⁾ gonovine maleate 10 µg 2 ,
10 µg 3
Bruce protocol 12
가 가
2 3
가

Table 1. Patients characteristics

No. of patients	34
Male : Female	28 : 6
Mean age (years)	53 ± 8
Clinical diagnosis at admission	
Typical variant angina	18
Pure spasm	13
Mixed disease	5
Unstable angina	15
Pure spasm	11
Mixed disease	4
Exertional angina	1
Pure spasm	1
Mixed disease	0

Pure spasm : coronary spasm with fixed stenosis <50%
Mixed disease : coronary spasm with fixed stenosis >50%, <70%

		pr - otocol		(symptom limited)	
		stage			
		12			
				가	
		Bruce protocol		stage 1	
		30		15%, 4.5 MPH	
		2가			
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		80 ms			
		2		1) 1 mm	
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200 µg		17)		34 29	
ergonovine				5	
가					
12					
		30			
2		ergonovine(20	
µg 2 ,		20 µg 3)		1	
		. 2		(high di -	
		ergonovine		(low di -	
		4		16)	
				Chi square test	
				Fisher's exact	
		24		Student unpaired t -	
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				test paired t - test	
				. p<0.05	
		(08 : 30 12 :			
00)				결 과	
18		, 16			
				단계적 운동부하 검사와 비단계적 운동부하 검사의 비교	
		Bruce			

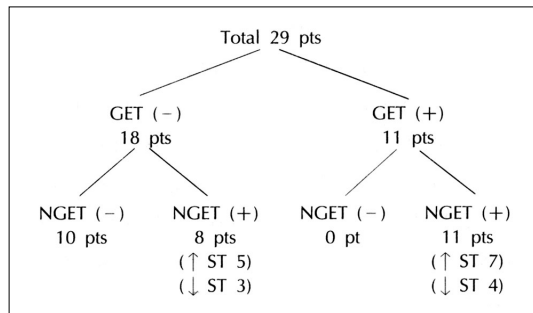


Fig. 1. Results of exercise provocation test in 29 patients with vasospastic angina who underwent both the graded and non-graded treadmill exercise ECGs. The graded exercise test (GET) was performed based on the Bruce's protocol and the non-graded exercise test (NGET) on the sudden exercise protocol. pts : patients, (+) : positive ECG response, (-) : negative ECG response, ↑ ST : ST segment elevation, ↓ ST : ST segment depression.

29 Bruce protocol
11 (38%)

11 ST 4
ST
, 3 2가 ST
, 4
ST ST
18 8
ST , 3 8 5
(Figs. 1 and 2).
19 (66%)
(Fig. 3).

METS(metabolic equivalents) 가 ST
가 (Table 2). (가
)
5
4 , 1

운동부하 검사상 양성인 환자와 음성인 환자의 임상적 특성의 비교

34
15 , 19

가 (Table 3).
14 , 20
9 (64%), 14 (70%)
(p=NS).
18 가
10
) 8 (80%)
가 8 4 (50%)
가 (Fig. 4).
고 찰

가
15)
Yamakado
75%
ST
70%
2가
Bruce protocol
가

가 ST
가
x
2가
가

가
18) 가

×

가

가

가

(work load)

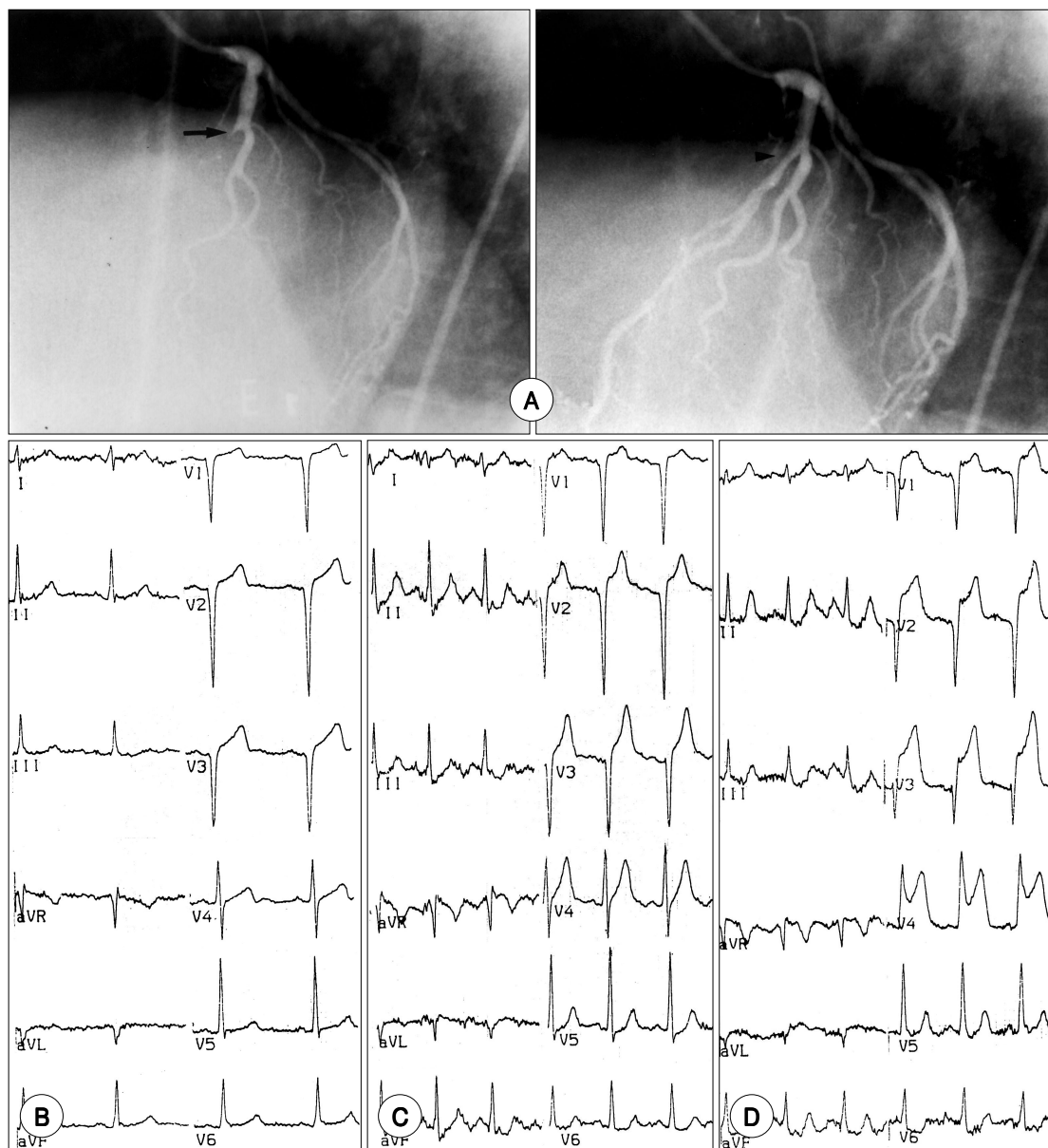


Fig. 2. A typical case of vasospastic angina patient showing different exercise ECG results by the two different modes of treadmill exercise. Total occlusion of the proximal left descending artery (arrow) was induced after intracoronary ergonovine 10 μ g injection, which was relieved after intracoronary nitroglycerin injection (arrow head, A). At peak exercise (11 min 59 sec) significant ST segment change was not detected on the graded treadmill exercise ECG based on Bruce's protocol (C) compared with the resting ECG (B). However, at 3 min 30 sec of exercise marked elevation of ST segment in precordial leads (V1-4) was noted, accompanied by chest pain, on the non-graded exercise ECG based on the sudden rapid exercise protocol (D).

가 2가

가

“ warm - up phenomenon ”

가

가

“ warm - up phenomenon ” (dynamic stenosis)

가

가 24

Sueda 17)

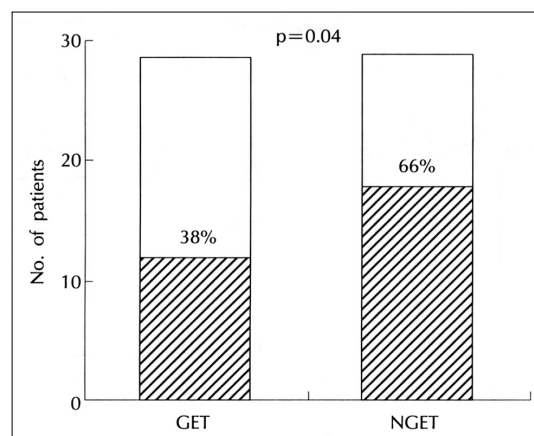


Fig. 3. Prevalence of the positive ECG response during the graded (GET) and the non-graded treadmill exercise test (NGET) in 29 patients with vasospastic angina who underwent both tests.

Bruce protocol

Bruce protocol 1

가

가

67%

Table 3. Comparison of clinical characteristics between patients with positive and negative graded treadmill exercise test

	Positive GET (n = 15)	Negative GET (n = 19)	p
Hypertension	7	3	NS
Diabetes	0	0	NS
Current smoking	11	10	NS
Hx of effort chest pain	6	8	NS
Mixed disease	6	3	NS
Total cholesterol (mg/dL)	166 ± 30	165 ± 20	NS

GET : graded exercise test by the Bruce's protocol, Hx : history, Mixed disease : coronary spasm with fixed stenosis >50%, <70%

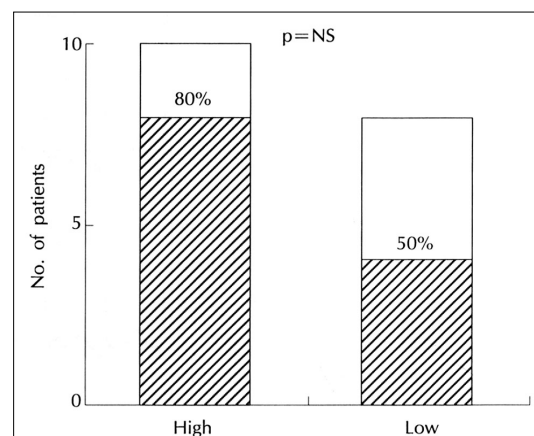


Fig. 4. Prevalence of the positive ECG response according to the disease activity during the exercise treadmill (graded or non-graded) test in 18 patients with typical variant angina. High : 5 times or more chest pain attack per week, Low : less than 5 times attack per week.

Table 2. Comparison of parameters in the two different modes of treadmill exercise test

	GET	NGET	p
HRmax(beats/min)	150 ± 20	156 ± 20	NS
Systolic BPmax(mmHg)	161 ± 16	156 ± 15	NS
Rate pressure product	24309 ± 4684	24345 ± 4232	NS
Work load(METS)	10 ± 2	11 ± 3	<0.01
Exercise time(sec)	515 ± 141	148 ± 80	<0.001

GET : graded exercise test by the Bruce's protocol, NGET : non-graded exercise test by the sudden rapid exercise protocol, HR : heart rate, BP : blood pressure, METS : metabolic equivalents

가

66%

가

가

20)

가

Oh 21)

19)

3

6

Lim 22)

(9 : 00 12 : 00)

(6 : 00 8 : 00)

Sakata 19)

(6 : 00 8 : 00)

가

(34 ± 5 vs. 18 ± 3%),

50%

가

50%

6/9(67%)

9/25(36%)

가

()

가

가

Waters 13)

de Servi 14)

ST

ST

Waters 13)

가

2/9(22%) 2/

25(8%) , ST

4/9(44%)

7/25(28%)

ST

가

가

가

가

가 가 ,

(pre -

²³⁾ conditioning effect)²⁴⁾ 가

ST

■ 본 연구의 제한점

1)

3) (가

) ergonovine

2

가 가

5 가

가

()

가 가

가 가

가

가

4) 가

Bruce protocol

48

가

가

■ 본 연구의 임상적 의의

2)

2가

cross - over

가

가

2 3

가 8 4 (50%)

가

결 론 :

가

중심 단어 :

요 약

연구목적 :

가

가 가

대상 및 방법 :

70%
ergonovine

34

Bruce protocol
(

)

결 과 :

1)

29

11 (38%),

19 (66%)

(p=0.04).

2) 34

50% , 70%

18

(5) 10

)

가

8 (80%),

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