

관동맥연축의 진단을 위한 Ergonovine Echocardiography의 안전성 및 임상적 유용성

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Safety and Clinical Impact of Ergonovine Stress Echocardiography for Diagnosis of Coronary Vasospasm

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ABSTRACT

Background : The safety of ergonovine provocation for coronary vasospasm (CVS) performed outside the catheterization laboratory has been questioned. We sought to address the issues of safety, feasibility and clinical impact of noninvasive diagnosis of CVS. **Method and Results :** We retrospectively analyzed the results of bedside ergonovine provocation testing with monitoring of left ventricular regional wall motion abnormalities (RWMAs) by 2-dimensional echocardiography (ergonovine echocardiography, Erg Echo). After confirmation of no significant fixed epicardial coronary artery disease, 1,504 Erg Echo were performed in 1,372 patients from July 1991 to December 1997. Erg Echo was prematurely terminated in 13 patients (0.9%) due to limiting side effects unrelated with myocardial ischemia. Among 1,491 completed tests, 32% (477) showed positive results with development of RWMAs in 467 tests (98%) or ST displacement in ECG in 10 tests (2%). During the test, transient arrhythmias developed in 1.7% (26/1491) including transient ventricular tachycardia (2) and atrioventricular block (4), which were promptly reversed with nitroglycerin. There were no procedure-related death or development of myocardial infarction. On the basis of angiographic criteria in 218 patients, who also underwent invasive spasm provocation test during coronary angiography, the sensitivity and specificity of Erg Echo for the diagnosis of CVS were 93% and 91% respectively. From 1990 to 1997, total 2,073 spasm provocation tests were performed either during invasive coronary angiography in the catheterization or in the echocardiography laboratory. Since 1994, noninvasive Erg Echo became a more popular diagnostic method and comprised more than 95% of all spasm provocation tests in recent 3 years. Erg Echo was also performed safely in outpatient clinic setting without hospital admission in 34% (500/1491). **Conclusions :** Erg Echo is highly feasible, accurate and safe for diagnosis of CVS and can replace the invasive spasm provocation test during coronary angiography in the catheterization laboratory. (**Korean Circulation J 2000;30(8):937-946**)

KEY WORDS : Coronary vasospasm · Noninvasive diagnosis · Ergonovine echocardiography.

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가

1) 14)15) 가 RWMAs
Erg Echo

(variant angina)
(effort - induced angina)

2-4)

가 8)

5)

Erg Echo

방 법

1990 1997 12

6-8)

(regional wall motion
abnormalities, RWMAs)

Ergonovine Echocardiography¹⁴⁾¹⁵⁾

가

2

20 Fig. 1 Erg Echo
10)11) Distant Ergonovine maleate

50 µg 5
350 µg 12

RWMA 가 ergonovine 3

ergonovine

quad - screen cine - loop

ergonovine echocardiography(Erg Echo)가 RWMA (hy -
pokinetik), (akinetic) (dy -

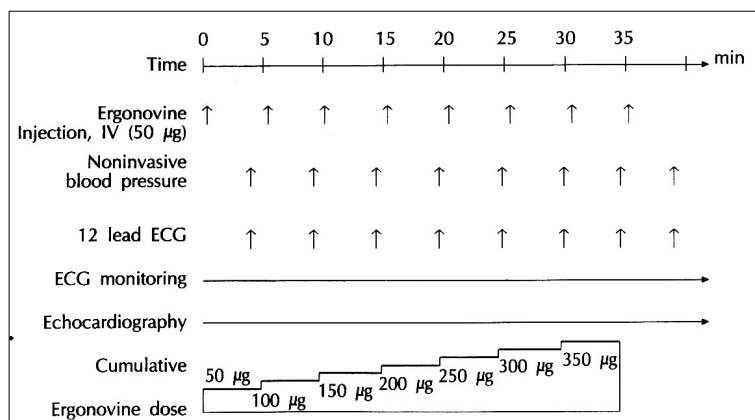


Fig. 1. Protocol of ergonovine echocardiography.

skintetic)가 . RWMA (Fig. 2A and B).¹⁶⁾

16

12

J point 0.08

RWMA

ST

0.1 mV

(

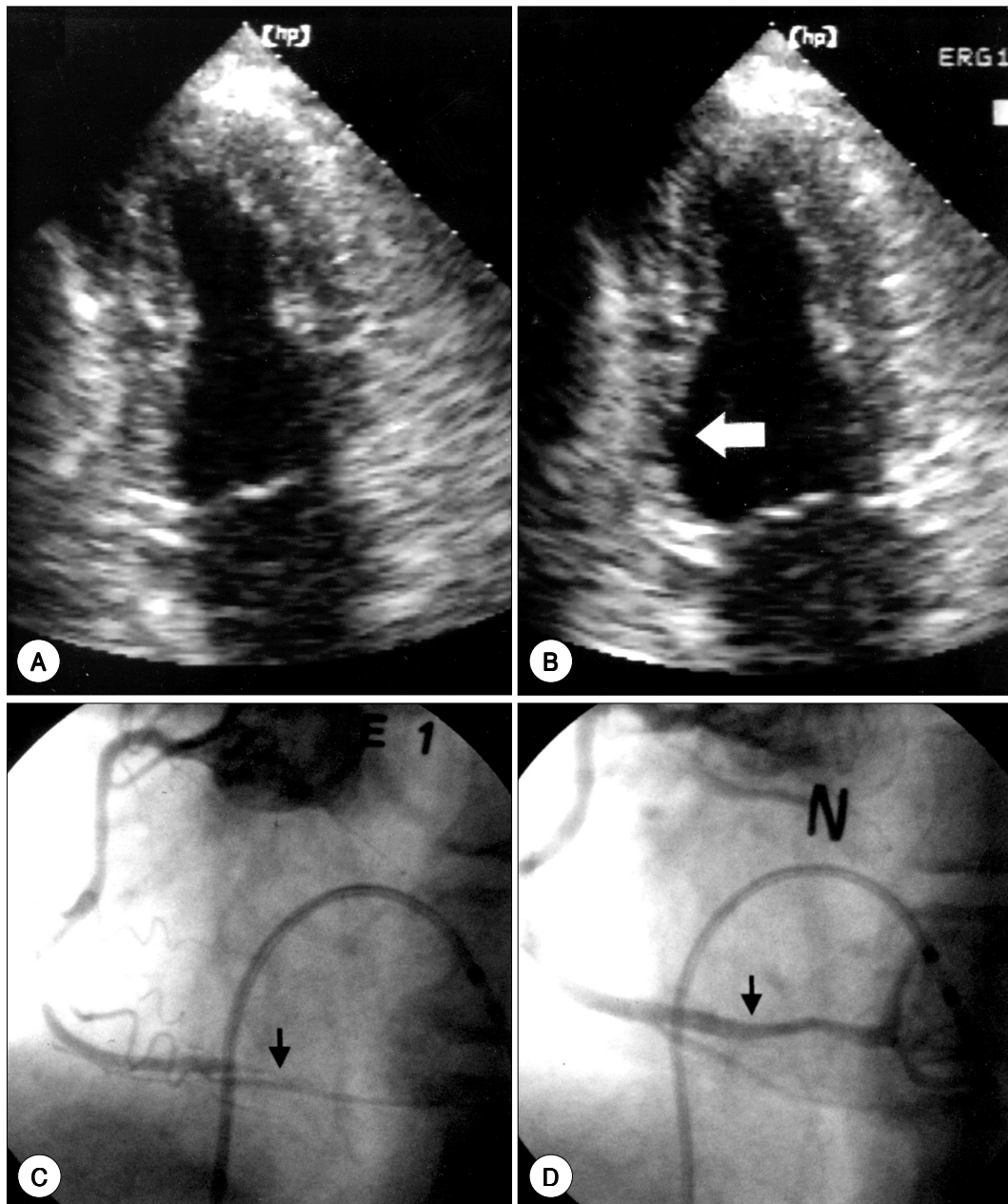


Fig. 2. Representative example of ergonovine echocardiography (A and B) and invasive spasm provocation testing during diagnostic coronary angiography (C and D) in a 47 year old man. Left ventricular wall motion at end-systole recorded in the apical two-chamber view was demonstrated (A and B). Compared to the basal status (A), prominent loss of systolic myocardial thickening in the inferior wall developed with an ergonovine dose of 0.15 mg (B; white arrow), which was compatible with myocardial ischemia due to coronary artery spasm in the right coronary artery territory. Coronary angiogram taken 3 days later revealed no significant fixed disease (D). Intravenous injection of ergonovine (E1) provoked total occlusion of the distal right coronary artery (C), which was compatible with coronary artery spasm.

) 가 RWMAsga 2 × 2
 () (categorical variables) chi-square test
 , p 0.05
 , ergonovine 350 μg
 200
 mmHg 90 mmHg
 nitroglycerin(250 μg) 600 μg 1991 7 1997 12 1,372
 Nifedipine (10 mg) 1,504 Erg Echo가 가 908
 , 가 464 53 ± 10 (19
 ergonovine 80) . Erg Echo
 . Ergonovine 350 μg 46% 가
 가 32%
 Thallium scan 22%
 가 Erg Echo (91%)
 dipyridamole - Thallium 201 가 , 가 7%
 , 2%
 . Fig. 3 Erg
 , nitrates Echo
 5 nitroglycerin (42%) Erg Echo
 150/90 mmHg 가
 Erg Echo
 Erg Echo의 실행성(feasibility), 진단정확도 및 안정성
 Erg Echo 0.9% 13
 관동맥조영술 및 침습적 연속유발검사
 Judkins Sones
 50% 200 mmHg
 5 , 90 mmHg 2
 가 3 , 2 ,
 acetylchoine¹⁸⁾ ergonovine⁵⁾¹⁷⁾ (back pain) 1
 가 10
 subtotal occlusion ST 1491 가 32%
 477 1014
 (Fig. 2C and D). . 477 98% 467
 RWMAsga
 통계분석 10 RWMAsga
 ± . Erg Echo ST

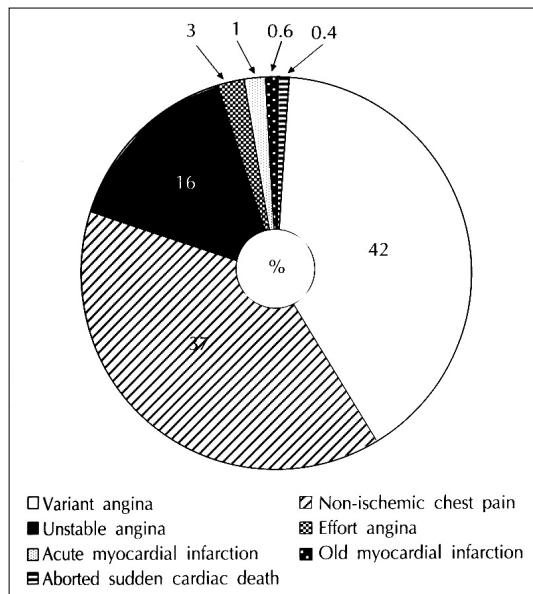


Fig. 3. Clinical diagnosis before ergonovine echocardiography.

Table 1. Final results of ergonovine echocardiography and invasive coronary angiography with spasm provocation test

	Invasive (+)	Provocation (-)
Ergonovine (+)	142	6
Echocardiography (-)	10	60

Sensitivity : 93%, specificity : 91%

(+) predictive value : 96%, (-) predictive value : 86%

Table 2. Prevalence of positive test according to the clinical diagnosis (%)

	N	(+)	%
Variant angina	522	232	44
Non-ischemic chest pain	526	32	6
Unstable angina	235	113	48
Effort angina	48	11	23
Acute myocardial infarction	20	4	20
Old myocardial infarction	8	0	0
Sudden cardiac death	4	2	50

50% 가
10%, 32% . 6%
RWMA's 6%
RWMA's가
가 3%,
가 2%,
가
1%
Erg Echo 218 가
가 Table 1
Erg Echo 93%(142/152),
91%(60/66), 96%(142/146),
86%(60/70) . Erg Echo
93%(202/218)
Erg Echo 1.9%(26/1491)
10 , 10
가
2
350 µg ergono -
vine RWMA's 1

4
RWMA's 477 34%
12 ST
, 10% ST T
, 10%
가 46% RWMA's
가
임상적 효과
Table 2
Erg Echo
Erg Echo
Erg Echo가
1990 1997 12
2,073
가 . 1992

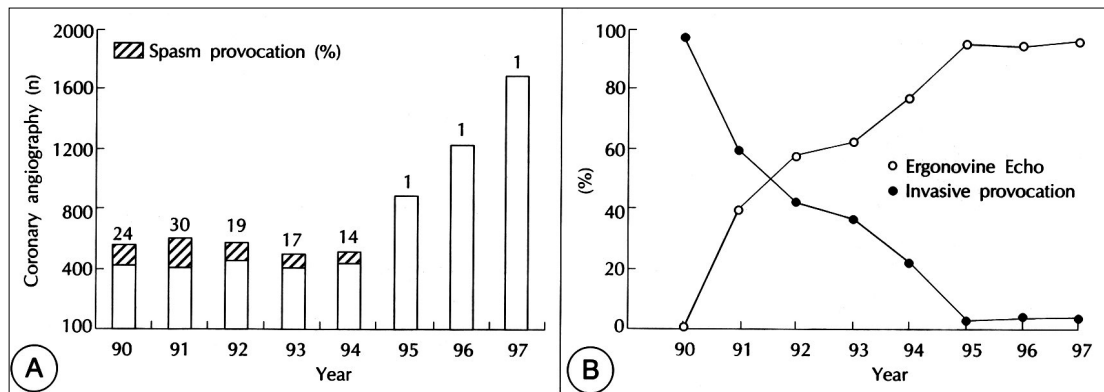


Fig. 4. Temporal changes of frequency of invasive spasm provocation testing in the catheterization laboratory (A) and increased usage of ergonovine echocardiography (B) for diagnosis of coronary artery spasm.

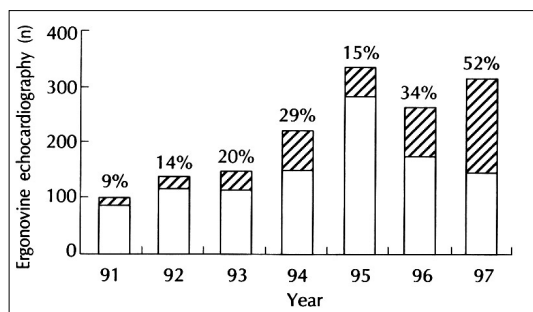


Fig. 5. Temporal changes of frequency of ergonovine echocardiography performed in the outpatient clinic without hospital admission.

고 안

Erg Echo가

가
(Fig. 4A).
Erg Echo가

(Fig. 4B).

19)20)

Erg Echo

1491 34% 500

14)

가 (Fig. 5) 1997

Erg Echo

가 ,

가

20% (101/500)

“

(de -

(37%, 370/991)

mand ischemia) ”

가

“ (supply ischemia) ”

가 Erg Echo가 Erg Echo가 가

RWMAs Echo가 Erg Echo가 가

가 가

본 연구의 문제점

Erg Echo²⁸⁾ 가²⁹⁾

가 ergonovine (hyperventilation)²⁶⁾²⁷⁾ Erg Echo

Erg Echo 가 요 약

연구목적 :

ergonovine 가 가

방 법 : Ergonovine (regional wall motion abnormalities, RWMAs) ergonovine echocardiography(Erg Echo)

임상에 미치는 영향 가

결 과 :

1991 7	1997 12	1,372
1,504	Erg Echo가	Erg Echo
0.9%	13	
		1,491
32% 477		98%(467)
가 RWMAs	10	ST
가		1.9%(26/1372)
		2

4

218 Erg Echo
가
Erg Echo
93%,
91% 1994 Erg Echo가
3 95%
500 Erg Echo가

결 론 :

Erg Echo

중심 단어 :

REFERENCES

- 1) Maseri A. Role of coronary artery spasm in symptomatic and silent myocardial ischemia. *J Am Coll Cardiol* 1987; 9:249-62.
- 2) Prinzmetal M, Kennamer R, Merliss R, Wade T, Bor N. Angina pectoris. The variant form of angina pectoris. *Am J Med* 1959;27:375-88.
- 3) MacAlpin RN, Kattus AA, Alvaro AB. Angina pectoris at rest with preservation of exercise capacity: Prinzmetal's variant angina. *Circulation* 1973;47:946-58.
- 4) Maseri A, Severi S, L'Abbate A, et al. Variant angina: One aspect of a continuous incidence and clinical and coronary arteriographic findings in 138 patients. *Am J Cardiol* 1978;42:1019-35.
- 5) Heupler FA Jr, Proudfit WL, Razavi M, Shirey EK, Greenstreet R, Sheldon WC. Ergonovine maleate provocative test for coronary arterial spasm. *Am J Cardiol* 1978; 41:631-40.
- 6) Buxton A, Goldberg S, Hirshfeld JW, et al. Refractory ergonovine-induced vasospasm: Importance of intracoronary nitroglycerin. *Am J Cardiol* 1980;46:329-34.
- 7) Pepine CJ, Feldman RJ, Conti CR. Action of intracoronary nitroglycerin in refractory coronary artery spasm. *Circulation* 1982;65:411-4.
- 8) Pepine CJ. Ergonovine echocardiography for coronary spasm: Facts and wishful thinking (editorial comments). *J Am Coll Cardiol* 1996;27:1162-3.
- 9) Nesto RW, Kowalchuck GJ. Ischemic cascade: Temporal sequence of hemodynamic, electrocardiographic and symptomatic expressions of ischemia. *Am J Cardiol* 1987; 59(Suppl C):23C-30C.
- 10) Feigenbaum H. Exercise echocardiography. *J Am Soc Echocardiogr* 1988;1:161-6.
- 11) Picano E. Stress echocardiography: From pathophysiological toy to diagnostic tool. *Circulation* 1992;85:1604-12.
- 12) Distant A, Rovai D, Picano E, et al. Transient changes in left ventricular mechanics during attack of Prinzmetal's angina; A two-dimensional echocardiography study. *Am Heart J* 1984;108:440-6.
- 13) Rovai D, Distant A, Moscarelli E, et al. Transient myocardial ischemia with minimal electrocardiographic changes; An echocardiographic study in patients with Prinzmetal's angina. *Am Heart J* 1985;109:78-83.
- 14) Song JK, Park SW, Kim JJ, et al. Values of intravenous ergonovine test with two-dimensional echocardiography for diagnosis of coronary artery spasm. *J Am Soc Echocardiogr* 1994;7:607-15.
- 15) Song JK, Lee SJK, Kang DH, et al. Ergonovine echocardiography as a screening test for diagnosis of vasospastic angina before coronary angiography. *J Am Coll Cardiol* 1996;27:1156-61.
- 16) American society of echocardiography committee on standards, subcommittee on quantitation of two-dimensional echocardiograms : Schiller NB, Shah PM, Crawford M, et al. Recommendation for quantitation of the left ventricle by two-dimensional echocardiography. *J Am Soc Echocardiogr* 1989;2:358-67.
- 17) Hackett D, Larkin S, Chierchia S, Davies G, Kaski JC, Maseri A. Induction of coronary artery spasm by a direct local action of ergonovine. *Circulation* 1987;75:577-82.
- 18) Yasue H, Horio Y, Nakamura N, et al. Induction of coronary artery spasm by acetylcholine in patients with variant angina: Possible role of the parasympathetic nervous system in the pathogenesis of coronary artery spasm. *Circulation* 1986;74:955-63.
- 19) Picano E, Mathias W Jr, Pingitore A, et al. on behalf of the EDIC study group. Safety and tolerability of dobutamine-atropine stress echocardiography: A prospective, large scale, multicenter trial. *Lancet* 1994;344:1190-2.
- 20) Seknus MA, Marwick TH. Evolution of dobutamine echocardiography protocols and indications: Safety and side effects in 3,011 studies over 5 years. *J Am Coll Cardiol* 1997;29:1234-40.
- 21) Pepine CJ, Feldman RL, Conti CR. Recommendations of use of ergonovine to provoke coronary artery spasm. *Catheter Cardiovasc Diagn* 1980;6:423-6.
- 22) Helfant RH. Coronary arterial spasm and provocative testing in ischemic heart disease. *Am J Cardiol* 1987; 41:787-9.
- 23) Waters DD, Theroux P, Szlachet J, et al. Ergonovine testing in a coronary care unit. *Am J Cardiol* 1980;46: 922-30.
- 24) Distant A, Picano E, Moscarelli E, Morales MA, Palombo C, L'Abbate A. Echocardiographic versus hemodynamic monitoring during attacks of variant angina pectoris. *Am J Cardiol* 1985;55:1319-22.
- 25) Morales MA, Lombardi M, Distant A, Carpeggiani C, Reisenhofer B, L'Abbate A. Ergonovine-echo test to assess the significance of chest pain at rest without ECG changes. *Eur Heart J* 1995;16:1361-6.

- 26) Fujii H, Yasue H, Omura K, *et al.* Hyperventilation-induced simultaneous multivessel coronary spasm in patients with variant angina; An echocardiographic and arteriographic study. *J Am Coll Cardiol* 1988;12:1184-92.
- 27) Previtalli M. Hyperventilation test. In: Picano E, editor. *Stress Echocardiography*. 3 rd ed. Springer-Verlag Berlin Heidelberg New York;1997. p.134-8.
- 28) Song JK, Park SW, Kang DH, *et al.* Diagnosis of coronary vasospasm in patients with clinical presentation of unstable angina pectoris using ergonovine echocardiography. *Am J Cardiol* 1998;12:1475-8.
- 29) Myerburg RJ, Kessler KM, Mallon SM, *et al.* Life threatening ventricular arrhythmias in patients with silent myocardial ischemia due to coronary artery spasm. *New Engl J Med* 1992;326:1451-5.