

관상동맥 스텐트 재협착 예측인자로서 QT 분산의 가치

김남호¹ · 조정관² · 이상현¹ · 박형욱¹ · 강경태¹ · 김계훈¹ · 김 원¹
이승욱¹ · 김건형¹ · 조장현¹ · 안영근¹ · 정명호² · 박종춘² · 강정채²

Value of QT Dispersion as a Predictor of Coronary Artery Stent Restenosis

Nam Ho Kim, MD¹, Jeong Gwan Cho, MD², Sang Hyun Lee, MD¹, Seung Uk Lee, MD¹,
Hyung Wook Park, MD¹, Kyung Tae Kang, MD¹, Kye Hun Kim, MD¹, Weon Kim, MD¹,
Kun Hyung Kim, MD¹, Jang Hyun Cho, MD¹, Young Keun Ahn, MD¹,
Myung Ho Jeong, MD², Jong Chun Park, MD² and Jung Chae Kang, MD²

¹Division of Cardiology, Chonnam National University Hospital, ²The Research Institute of Medical Sciences, Chonnam National University, Kwangju, Korea

ABSTRACT

Background : QT dispersion (QTd) in 12-lead ECG, a noninvasive parameter of the degree of inhomogeneous myocardial repolarization, has been reported useful in assessing the risk of ventricular tachyarrhythmias and sudden cardiac death in patients with coronary artery disease. Restenosis after coronary stenting was not infrequent. However, there was no reliable ECG predictor for stent restenosis. This study was performed to evaluate the value of QTd as a predictor of coronary artery stent (CAS) restenosis. **Methods :** One hundred eighty eight patients who underwent both successful coronary artery stenting for significant coronary artery stenosis and follow-up coronary artery angiography were included in this study. QTcd (difference of maximum and minimum QTc intervals) was measured in the 12-lead surface ECG, which was recorded 6 -12 hours after the successful CAS and 12 -18 hours before the follow-up coronary angiography, which was performed 1 -12 months (Group I : 6 ±3 months ; Group II : 7 ±2 months, p = NS) after CAS. The follow-up coronary angiography demonstrated no restenosis of the stented coronary artery in 122 patients (Group I : 97 men, 25 women ; 58 ±13 years), but restenosis in 66 patients (Group II : 58 men, 8 women ; 61 ±13 years). **Results :** There were no significant differences in the distribution of the target vessels between the two groups. The minimal luminal diameters of the target vessels were similar in the two groups before and after CAS (0.99 ±0.49 mm vs. 0.92 ±0.51 mm ; 2.94 ±0.71 mm vs. 2.71 ±0.79, respectively). QTcd after CAS was 52.6 ±22.0 ms in the Group I and 51.6 ±30.5 ms in the Group II, with no significant difference between the two groups. QTcd at the follow-up examination was 50.0 ±19.8 ms in the Group I and 58.3 ±21.6 ms in the Group II, showing a significant difference between the two groups (p <0.05). The change in QTcd (QTcd) during the follow-up period was significantly different between the two groups : QTcd significantly increased in the Group II, particularly in patients with angina pectoris, single or two-vessel disease, or left coronary artery stenosis, compared with the Group I (Group I : -2.18 ±22.11 ms, Group II : 8.77 ±28.82 ms, p <0.05). The sensitivity, specificity, negative predictive value, positive predictive value and diagnostic accuracy of QTcd

: 1999 8 24
: 2000 4 28
: , 501 - 757 8
: (062) 220 - 6242 · : (062) 225 - 8578
Email : chojg@unitel.co.kr

KEY WORDS : Coronary stent · Restenosis · QT dispersion.

Korean Circulation J 2000;30(5):555-562

추적 관찰

aspirin 100~300 mg

ticlopidine 500 mg

4

6

50%

통계 분석

±

unpaired Student's t-test, chi-square

test, p 0.05

관상동맥조영술 소견

I 80 (65.6%), II 25 (20.5%), 48 (72.7%), 5 (7.6%), 13 (19.7%)

AHA/ACC I A 8 (6.6%), B 81 (66.4%), C 33 (27.0%), II A 6 (9.1%), B 43 (66.7%), C 16 (24.2%)

결 과

임상적 특징

I II

가 . I 56 (45.9%), 26 (39.4%), 33 (27.0%), 26 (39.4%), 20 (16.4%), 13 (10.7%), 7 (10.6%), 7 (10.7%)

I II

68 (55.7%), 44 (66.7%), 26 (21.3%), 14 (21.2%), 50 (41.0%), 24 (36.4%), 20 (16.4%), 9 (13.6%)

추적 관상동맥조영술 결과

I II

0.99 ± 0.49 mm, 0.92 ± 0.51 mm,

Table 1. Baseline clinical characteristics

	Group (No Restenosis, N = 122)	Group (Restenosis, N = 66)	P
Age (years)	56 ± 10	57 ± 10	NS
Sex (male/female)	97/25	58/8	NS
Ejection fraction (%)	58.4 ± 13.3	61.4 ± 12.5	NS
Follow-up (months)	6 ± 3	7 ± 2	NS
Clinical diagnosis (%)			NS
Acute myocardial infarction	55 (45.1)	23 (34.8)	
Unstable angina	63 (51.6)	35 (53.0)	
Stable angina	4 (3.3)	8 (12.1)	
Risk factor (%)			
Current smoking	68 (55.7)	44 (66.7)	NS
Hypercholesterolemia	26 (21.3)	14 (21.2)	NS
Hypertension	50 (41.0)	24 (36.4)	NS
Diabetes mellitus	20 (16.4)	9 (13.6)	NS

Values are expressed as mean value ± SD or number (%) of patients. NS : not significant

2.94 ± 0.71 mm, 2.71 ± 0.79 mm 22.0 ms, 51.6 ± 30.5 ms
가 . 50.0 ± 19.8 ms, 58.3
I II 1.70 ± 0.56 mm, 0.71 ± 0.41 ± 21.6 ms 가
mm II (p < 0.05, Table 3). (p < 0.05, Table 4).
QT 분산 QT (QTcd) I - 2.18 ± 22.11
ms, II 8.77 ± 28.82 ms II
QTc I II (p < 0.05, Fig. 1). QTcd
417.2 ± 30.3 ms, 405.7 ± 33.1 ms, I - 4.69 ± 24.68 ms, II 6.72 ±
396.6 ± 21.8 ms, 401.3 ± 40.2 ms 30.01 ms, 3.44 ± 16.03 ms,
가 . QTc I 28.62 ± 34.72 ms II
II 52.6 ± (p < 0.05), I II

Table 2. Target lesion characteristics

	Group	(No Restenosis, n = 122)	Group	(Restenosis, n = 66)	P
Target vessel (%)					NS
LAD		80 (65.6)		48 (72.7)	
LCX		17 (13.9)		5 (7.6)	
RCA		25 (20.5)		13 (19.7)	
ACC/AHA lesion classification (%)					NS
Type A		8 (6.6)		6 (9.1)	
Type B1		54 (44.3)		27 (40.9)	
Type B2		27 (22.1)		17 (25.8)	
Type C		33 (27.0)		16 (24.2)	
Number of diseased vessels					NS
1		67 (54.9)		38 (57.6)	
2		42 (34.4)		21 (31.8)	
3		13 (10.7)		7 (10.6)	
Indications for stenting (%)					NS
Elective		56 (45.9)		26 (39.4)	
Restenosis		33 (27.0)		26 (39.4)	
Suboptimal PTCA		20 (16.4)		7 (10.6)	
Bailout		13 (10.7)		7 (10.6)	
Types of stent					NS
Palmaz-Schatz stent		34 (27.9)		18 (27.3)	
Microstent II		32 (26.2)		17 (25.8)	
Freedom stent		39 (32.0)		19 (28.8)	
Others		17 (13.9)		12 (18.2)	

LAD : left anterior descending artery, LCX : left circumflex artery, RCA : right coronary artery, ACC/AHA : American College of Cardiology/American Heart Association, PTCA : percutaneous transluminal coronary angioplasty, NS : not significant

Table 3. Quantitative coronary angiographic data

	Group	(No Restenosis, n = 122)	Group	(Restenosis, n = 66)	P
Minimal luminal diameter (mm)					
Before stenting		0.99 ± 0.49		0.92 ± 0.51	NS
Immediately after stenting		2.94 ± 0.71		2.71 ± 0.79	NS
At 6-month follow-up		1.70 ± 0.56		0.71 ± 0.41	<0.05

NS : not significant

Table 4. QT interval and QT dispersion

	Group	(No Restenosis, n = 122)	Group	(Restenosis, n = 66)	P
QT interval (ms)					
Post-stenting		397.2 ± 44.6		391.4 ± 35.4	NS
Follow-up		387.7 ± 36.3		398.4 ± 43.3	NS
QTc interval (ms)					
Post-stenting		417.2 ± 30.3		405.7 ± 33.1	NS
Follow-up		396.6 ± 21.8		401.3 ± 40.2	NS
QTd (ms)					
Post-stenting		49.5 ± 20.7		49.1 ± 28.7	NS
Follow-up		48.6 ± 18.6		56.7 ± 19.7	<0.05
QTcd (ms)					
Post-stenting		52.6 ± 22.0		51.6 ± 30.5	NS
Follow-up		50.0 ± 19.8		58.3 ± 21.6	<0.05

QTd : QT dispersion, QTcd : corrected QT dispersion, NS : not significant

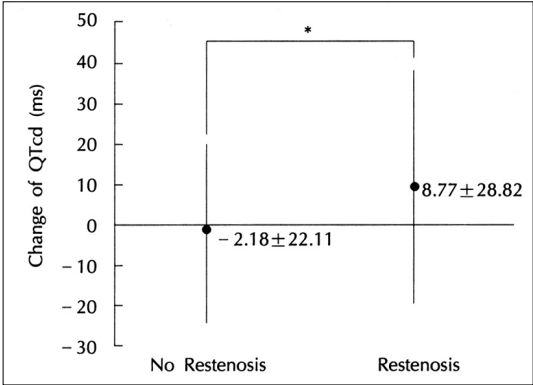


Fig. 1. Change of QTcd dispersion (QTcd) after successful coronary stenting. * : p<0.05

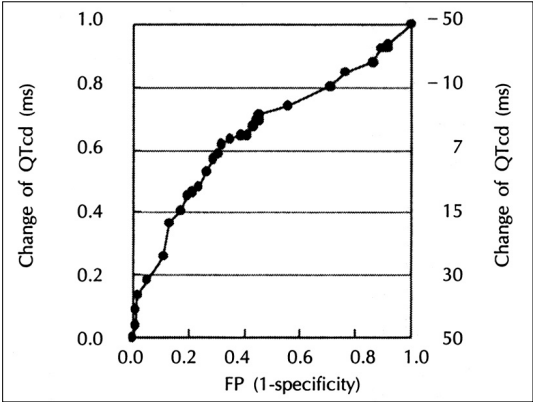


Fig. 2. ROC curve for prediction of coronary stent restenosis using QTcd. TP : true positive, FP : false positive.

2.01 ± 15.08 ms, 8.69 ± 19.70 ms
가 . QTcd
I II - 0.51 ± 21.93 ms
7.96 ± 29.56 ms, - 3.51 ± 22.86 ms 13.65 ±
22.90 ms II
(p<0.05), - 6.49 ± 21.32 ms
- 1.51 ± 40.65 ms 가
. QTcd I
- 2.22 ± 22.07 ms, II - 1.96 ± 37.83 ms
가 ,
- 2.15 ± 22.31 ms, 14.90 ± 20.20 ms II I
(p<0.05, Table 5).
ROC QTcd 7
ms , , 가
, , 64%, 65%, 4)15)16)

49%, 77%, 64% (Fig. 2).
고 안
1986 Sigwart¹⁾
2)3)
BENEST -
ENT STRESS
20~30%
가

Table 5. Change in QT dispersion (QTd) during follow-up

	Group	(No Restenosis)	Group	(Restenosis)	P
Total		N = 122		N = 66	
DQTd		0.01 ± 21.85		9.48 ± 27.82	< 0.05
DQTcd		- 2.18 ± 22.11		8.77 ± 28.82	< 0.05
Target vessels					
LAD		N = 80		N = 48	
QTd		- 2.37 ± 24.68		7.54 ± 28.99	< 0.05
QTcd		- 4.69 ± 24.68		6.72 ± 30.01	< 0.05
LCX		N = 17		N = 5	
QTd		6.45 ± 16.65		31.00 ± 31.13	< 0.05
QTcd		3.44 ± 16.03		28.62 ± 34.72	< 0.05
RCA		N = 25		N = 13	
QTd		3.26 ± 12.63		8.37 ± 19.16	NS
QTcd		2.01 ± 15.08		8.69 ± 19.70	NS
Disease vessels number					
1 vessel		N = 67		N = 38	
QTd		1.34 ± 20.63		8.41 ± 28.13	< 0.05
QTcd		- 0.51 ± 21.93		7.96 ± 29.56	< 0.05
2 vessels		N = 42		N = 21	
QTd		- 1.52 ± 25.11		14.67 ± 21.88	< 0.05
QTcd		- 3.51 ± 22.86		13.65 ± 22.90	< 0.05
3 vessels		N = 13		N = 7	
QTd		- 1.88 ± 17.28		- 0.23 ± 41.16	NS
QTcd		- 6.49 ± 21.32		- 1.51 ± 40.65	NS
Clinical diagnosis					
Acute myocardial infarction		N = 55		N = 24	
QTd		0.36 ± 20.40		- 1.24 ± 35.44	NS
QTcd		- 2.22 ± 22.07		- 1.96 ± 37.83	NS
Angina pectoris		N = 67		N = 42	
QTd		0.27 ± 23.13		15.61 ± 20.41	< 0.01
QTcd		- 2.15 ± 22.31		14.90 ± 20.20	< 0.01

Values are expressed as ms or number. QTd : QT dispersion, QTcd : corrected QT dispersion, LAD : left anterior descending artery, DQTd : change of QTd during follow-up, DQTcd : change of QTcd during follow-up, NS : not significant

1903 Einthoven 12 QT
Wilson 12 가가 가 . QT
12

가

가

가

QT

가

QT

.⁹⁻¹²) QT

QT

561

QTcd I 52.6 ± 22.0 ms, II 51.6 ± 30.5 ms
 QTcd I 50.0 ± 19.8 ms, II 58.3 ± 21.6 ms II
 (p<0.05). QTcd I -2.18 ± 22.11 ms, II 8.77 ± 28.82 ms II
 (p<0.05). QTcd
 QTcd(cut - off value, 7 ms)

64%, 65%, 49%, 77%, 64%

결론 :

QTc
 가 50% QT
 가

중심 단어 : QT

1998

REFERENCES

- 1) Sigwart U, Puel J, Mirkowitch V, Joffre F, Kappenberger L. Intravascular stents to prevent occlusion and restenosis after transluminal angioplasty. *N Engl J Med* 1987;316:701-6.
- 2) Coronary Stenting Study Groups. Palmaz-Schatz coronary stenting: Analysis of multicenter results. *Korean Circulation J* 1995;23:889-95.
- 3) Coronary Stenting Study Groups. Gianturco-Roubin coronary stenting: Analysis of multicenter results. *Korean Circulation J* 1995;25:896-902.
- 4) Jeong MH, Cho JJ, Seo JP, Rhyu MK, Lee MK, Ahn YK, et al. Clinical study for coronary artery stenting. *Korean Circulation J* 1994;24:373-9.
- 5) Statters DJ, Malik M, Ward DE, Camm AJ. QT dispersion: Problem of methodology & clinical significance. *J Cardiovasc Electrophysiol* 1994;5:672-85.
- 6) Higham PD, Campbell RWF. QT dispersion. *Br Heart J* 1994;71:508-10.
- 7) Zabel M, Portnoy S, Franz MR. Electrocardiographic indexes of dispersion of ventricular repolarization: An isolated heart validation study. *J Am Coll Cardiol* 1995;25:746-52.
- 8) Ducceschi V, Sarubbi B, Giasi A, Russo B, Lucca P, Santangelo L, et al. Correlation between late potential duration and QTc dispersion: Is there a causal relationship?. *International Journal of Cardiology* 1996;53:285-90.
- 9) Goldner B, Brandspiegel HZ, Horwitz L. Utility of QT dispersion combined with the signal-averaged electrocardiogram in detecting patients susceptible to ventricular tachyarrhythmia. *Am J Cardiol* 1995;76:1192-4.
- 10) Bogun F, Chan K, Harvey M, Goyal R, Castellani M, Niebauer M, et al. QT dispersion in nonsustained ventricular tachycardia and coronary artery disease. *Am J Cardiol* 1996;77:256-9.
- 11) Pye M, Quinn AC, Cobbe SM. QT interval dispersion: A non-invasive marker of susceptibility to arrhythmia in patients with sustained ventricular arrhythmias?. *Br Heart J* 1994;71:511-4.
- 12) Perkiomaki JS, Koistinen MJ, Yli-Mayry S, Huikuri HV. Dispersion of QT interval in patients with and without susceptibility to ventricular tachyarrhythmias after previous myocardial infarction. *J Am Coll Cardiol* 1995;26:174-9.
- 13) Batur MK, Aksoyek S, Oto A, Yildirim A, Ozer N, Atalar E, et al. Circadian variation of QTc dispersion: Is it a clue to morning increase of sudden cardiac death?. *Clin Cardiol* 1999;22:103-6.
- 14) Bazett HC. An analysis of the time-relations of electrocardiogram. *Heart* 1920;7:353.
- 15) Serruys PW, de Jaegere P, Kiemeny F, Macaya C, Rutsh W, Heyndrickx G, et al. A comparison of balloon-expandable stent implantation with balloon angioplasty in patients with coronary artery disease. *N Engl J Med* 1994;331:489-95.
- 16) Fishman DJ, Leon MB, Baim DS, Schatz RA, Savage MP, Penn I, et al. A randomized comparison of coronary artery stent placement and balloon angioplasty in the treatment of coronary artery disease. *N Engl J Med* 1994;33:498-501.
- 17) Choi H, Cha TJ, Park SM, Kim J, Choi HJ, Yoo HD, et al. Dispersion of QT interval and other repolarization indexes in acute myocardial infarction. *Korean Circulation J* 1997;27:1289-97.
- 18) Lee HS, Cross SJ, Rawles J. QTc dispersion in patients with coronary artery disease-Effect of exercise, dobutamine and dipyridamole myocardial stress. *Eur Heart J* 1993;14:210.
- 19) Perkiomaki J, Koistinen J, Linnaluoto M. Dispersion of QT-interval at rest and during exercise in healthy subjects and patients with coronary artery disease. *Eur Heart J* 1993;14:254.
- 20) Park HN, Kim YH, Park SW, Lim DS, Park CG, Seo HS, et al. Diagnostic value of QT and JT dispersion in exercise ECG. *Korean Circulation J* 1995;25:560-7.
- 21) Yunus A, Gillis AM, Traboulsi M, Duff HJ, Wyse DG, Knudtson ML, et al. Effect of coronary angioplasty on precordial QT dispersion. *Am J Cardiol* 1997;79:1339-42.
- 22) Kelly RF, Parillo JE, Hollenberg SM. Effect of coronary angioplasty on QT dispersion. *Am Heart J* 1997;134:399-405.
- 23) Aytemir K, Bavafa V, Ozer N, Aksoyek S, Oto A, Ozmen F, et al. Effect of balloon inflation-induced acute ischemia on QT dispersion during percutaneous transluminal coronary angioplasty. *Clin Cardiol* 1999;22:21-4.
- 24) Kim BS, Kang JH, Lee SW, Shim SC, Cho YK, Lee MH, et al. Effect of coronary angioplasty on QT and JT dispersion. *Korean Circulation J* 1998;28:1280-6.
- 25) Choi KJ, Lee IS, Lee SK, Hong MK, Park SW, Park SJ, et al. Change of QT dispersion following PTCA in angina pectoris. *Korean Circulation J* 1998;28:1487-92.