

관동맥 스텐트 시술에서 혈관내 초음파와 혈관조영술 간의 정량적 측정의 비교

김영학 · 홍명기 · 김진우 · 이상곤 · 이철환 · 정상식
최기준 · 강덕현 · 송재관 · 김재중 · 박성욱 · 박승정

= Abstract =

Comparison between Intravascular Ultrasound and Quantitative Coronary Angiographic Measurements in Coronary Artery Stenting

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Background : To overcome the limitation of angiography, intravascular ultrasound(IVUS) is widely used to guide coronary stent implantation. We compared the quantitative measurements of IVUS and quantitative coronary angiographic(QCA) analysis after stent implantation.

Methods : Thirty nine patients with 39 coronary lesions underwent coronary stent implantation. The implanted stents were CrossFlex stent in 17 , NIR stent in 13 , Palmaz-Schatz stent in 6, Multilink stent in 2 patients, and Divysio stent in 1 patient. Post-stent IVUS procedure with automatic pullback device was performed successfully in all patients after angiographic optimization. IVUS and QCA measurements included the minimum lumen diameter at proximal and distal reference artery, and stented site after intracoronary administration of 0.2mg nitroglycerin.

Results : IVUS and QCA measurement of minimal luminal diameter(MLD) at proximal and distal reference artery, and stented site correlated reliably each other($r = 0.62$, $p < 0.01$; $r = 0.77$, $p < 0.01$; $r = 0.73$, $p < 0.01$ respectively). Even if insignificant statistical difference, there was a tendency of larger MLD at proximal and distal reference artery by IVUS measurement than by QCA measurement($3.2 \pm 0.5\text{mm}$ vs. $3.1 \pm 0.4\text{mm}$, $p = 0.2$; $3.1 \pm 0.6\text{mm}$ vs. $3.0 \pm 0.7\text{mm}$, $p = 0.2$, respectively). The MLD at stented site was significantly larger by QCA measurement than by IVUS measurement($3.2 \pm 0.6\text{mm}$ vs. $2.9 \pm 0.5\text{mm}$, $p < 0.05$).

Conclusion : We concluded 1) the correlation between IVUS and QCA measurements of reference vessel and stented site was reliable. 2) There was a tendency of larger luminal diameter at

reference vessel by IVUS than by QCA. 3) The minimal luminal diameter was measured significantly larger at stented site by QCA than by IVUS.

KEY WORDS : Coronary stent · Intravascular ultrasound · Coronary angiogram.

서 론

cutaneous transluminal coronary angioplasty, PTCA) (per - 1,2) . (stent optimization) (intravascular ultrasound) 가 3 가 . aspirin ticlopidine 250mg , aspirin 200mg .

2. 스텐트 삽입술 10,000 activated clotting time 250 5,000 가 . (predilation) 가 1 : 1 CrossFlex 17 , NIR 13 , Palmaz - Schatz 6 , Mu - Italink 2 Divysio 1 . (high pressure balloon dilatation) 7,8) 14.8 . (stent optimization)가

연구대상 및 방법

1. 연구 대상 1997 3 1997 5 39 , 39 system .

nitroglycerin 0.2mg (guiding catheter) (reference vessel) ANCOR(V2, Siemens) .

4. 혈관내 초음파 촬영 및 정량적 분석 0.2mg nitro - glycerin (ultrasound)

thallium SPECT 가 2) 70% 3)

catheter) 10mm
(automatic pullback

device) Cardiova - Table 2
QCA

scular Imaging System

30 - MHz (transducer)가 360 가

가 (2.9F/3.2F) 가 가

9). 1/2 VHS , QCA

(Table 3).

QCA

(lumen)
external elastic membrane (cross
sectional area) (minor
and major diameter) 2

4

5. 통계 분석

±

two -
tailed t - test QCA

p

0.05

결 과

39 , Table 1

QCA

3.1 ± 0.5mm

0.8 ± 0.5mm

3.2 ± 0.6mm

가 ,

Table 1. Baseline clinical characteristics of the 39 patients

Age (years)	58 ± 9
Gender (Male/Female)	30/9
Risk factors	
Hypertension	13 (33%)
Diabetes mellitus	6 (15%)
Hypercholesterolemia	4 (10%)
Current smoker	21 (54%)
Myocardial infarction	
Healed	6 (15%)
Acute	8 (21%)
Unstable angina	22 (56%)
Number of narrowed coronary arteries	
1	25 (64%)
2	9 (23%)
3	5 (13%)
Lesion location	
Left anterior descending coronary artery	18 (46%)
Left circumflex coronary artery	4 (10%)
Right coronary artery	17 (44%)

Table 2. IVUS measurements after stent implantation

	Proximal reference	Stented segment	Distal reference
Lumen			
Cross-sectional area (mm ²)	8.8 ± 2.0	8.0 ± 3.2	8.5 ± 3.6
Minimum diameter (mm)	3.2 ± 0.5	2.9 ± 0.5	3.1 ± 0.6
Maximum diameter (mm)	3.4 ± 0.5	3.2 ± 0.7	3.3 ± 0.7
External elastic membrane			
Cross-sectional area (mm ²)	14.8 ± 3.3	15.6 ± 4.8	14.4 ± 6.6
Minimum diameter (mm)	4.1 ± 0.5	4.2 ± 0.7	4.0 ± 0.9
Maximum diameter (mm)	4.4 ± 0.5	4.5 ± 0.6	4.3 ± 0.9

IVUS ; intravascular ultrasound

Table 3. Comparison of IVUS and QCA measurement after stent implantation

Minimal luminal diameter	IVUS	QCA	p
Distal reference artery(mm)	3.1 ± 0.6	3.0 ± 0.7	0.2
Proximal reference artery(mm)	3.2 ± 0.5	3.1 ± 0.4	0.2
Stented site(mm)	2.9 ± 0.5	3.2 ± 0.6	<0.05

IVUS : intravascular ultrasound, QCA : quantitative coronary angiography

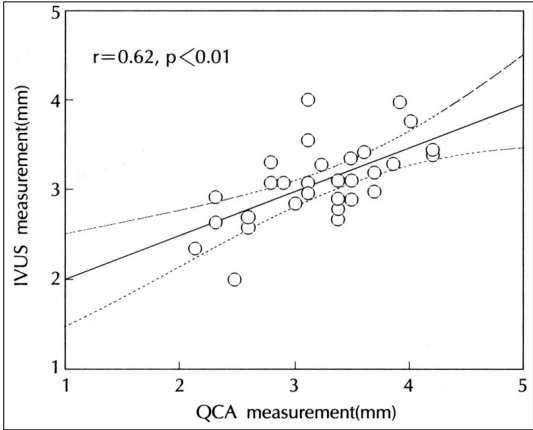


Fig. 1. The correlation between IVUS and QCA measurement of minimal luminal diameter at proximal reference artery. IVUS : Intravascular ultrasound, QCA : quantitative coronary angiography

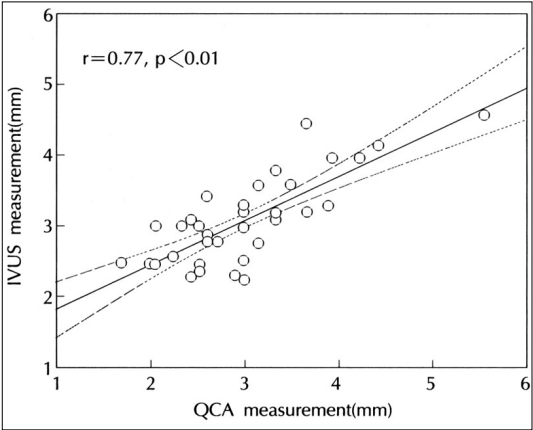


Fig. 3. The correlation between IVUS and QCA measurement of minimal luminal diameter at stented site. IVUS : Intravascular ultrasound, QCA : quantitative coronary angiography

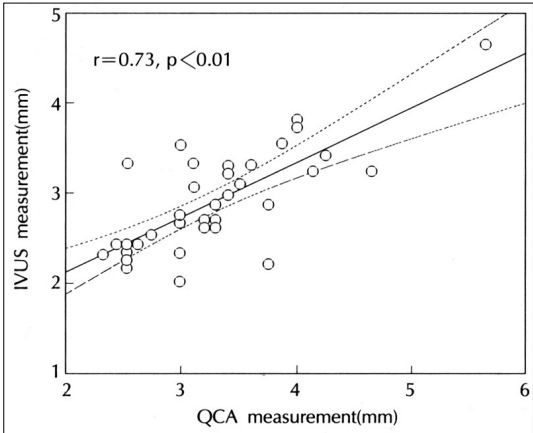


Fig. 2. The correlation between IVUS and QCA measurement of minimal luminal diameter at distal reference artery. IVUS : Intravascular ultrasound, QCA : quantitative coronary angiography

가 (Fig. 1, 2, 3).

고 안

(stent optimization)

가
10,11),
11 - 13),
14 - 16),
PTCA 가
(elastic recoil),
(pathologic arterial remodeling)
Nakamura 17) QCA
QCA 가
(plaque prolapse)
17,18).

요약

(QCA)

QCA

방 법 :

QCA

Cross - Flex
Schatz

QCA

0.2 mg

QCA

(angulation)

가

QCA

QCA 가

(3.2 ± 0.6mm vs. 2.9 ± 0.5mm,

결론 :

2)

QCA

가

References

- 1) Fischman DL, Leon MB, Baim DS, Schatz RA, Savage MP, Penn I, Detre K, Veltri L, Ricci D, Nobuyoshi M, Cleman M, Heuser R, Almond D, Teirstein PS, Fish D, Colombo A, Brinker J, Moses J, Shalovich A, Hirshfeld J, Bailey S, Ellis S, Rake R, Goldberg S for the Stent Restenosis Study Investigators : *A randomized comparison of coronary-stent placement and balloon angioplasty in the treatment of coronary artery disease. N Engl J Med* 331 : 496-501, 1994
- 2) Serruys PW, Jaegere P, Kiemeneij F, Macaya C, Rutsch W, Heyndrickx G, Emanuelsson H, Marco J, Legrand V, Materne P, Belardi J, Sigwart U, Colombo A, Goy JJ, Heuvel P, Delcan J, Morel MA, for the Benestent study group : *A comparison of balloon-expandable stent implantation with balloon angioplasty in patients with coronary artery disease. N Engl J Med* 331 : 489-495, 1994
- 3) Haas R : *Implantation and imaging of coronary stents. Radiologic Technology* 67 : 233-244, 1996
- 4) Itoh A, Miyazaki S, Nonogi H, Daikoku S, Haze K : *Angioscopic prediction of successful dilatation and restenosis in percutaneous transluminal coronary angioplasty. Significance of yellow plaque. Circulation* 91 : 1389-1396, 1995
- 5) Feld S, Ganim M, Carell ES, Kjellgren O, Kirkeeide RL, Vaughn WK, Kelly R, McGhie AI, Kramer N, Loyd D, Anderson HV, Schroth G, Smalling RW : *Comparison of angioscopy, intravascular ultrasound imaging and quantitative coronary angiography in predicting clinical outcome after coronary intervention in high risk patients. J Am Coll Cardiol* 28 : 97-105, 1996
- 6) den Heijer P, Foley DP, Escaned J, Hillege HL, van Dijk RB, Serruys PW, Lie KI : *Angioscopic versus angiographic detection of intimal dissection and intracoronary thrombus. J Am Coll Cardiol* 24 : 649-654, 1994
- 7) 박승정 · 박성욱 · 홍명기 · 김재중 · 정상식 · 이철환 · 김진우 · 체제건 · 강덕현 · 송재관 · 최기준 · 김유호 : *항응고요법 없이 고압력 풍선확장술을 이용한 관동맥내 Palmaz-Schatz stenting의 장기 추적 결과. 순환기* 27 : 56-64, 1997
- 8) Park SW, Park SJ, Hong MK, Kim JJ, Cho SY, Jang YS, Kim KB, Kim KS, Oh DJ, Oh BH, Kang JC : *Coronary stenting (Cordis) without anticoagulation. Am J Cardiol* 79 : 901-904, 1997
- 9) Mintz GS, Popma JJ, Pichard AD, Kent KM, Satler LF, Wong SC, Hong MK, Kovach JA, Leon MB : *Arterial remodeling after coronary angioplasty ; Serial intravascular ultrasound study. Circulation* 94 : 35-43, 1996
- 10) Colombo A, Hall P, Nakamura S, Almagor Y, Maiello L, Martini G, Gaglione A, Goldberg SL, Tobis JM : *Intracoronary stenting without anticoagulation accomplished with intravascular ultrasound guidance. Circulation* 91 : 1676-1688, 1995
- 11) Mudra H, Klauss V, Blasini R, Rieber J, Kroetz M, Regar E, Theisen K : *Ultrasound guidance of Palmaz-Schatz intracoronary stenting with a combined intravascular ultrasound balloon catheter. Circulation* 90 : 1252-1261, 1994
- 12) Colombo A, Hall P, Nakamura S, Almagor Y, Maiello L, Martini G, Gaglione A, Goldberg SL, Tobis JM : *Intracoronary stenting without anticoagulation accomplished with intravascular ultrasound guidance. Circulation* 91 : 1676-1688, 1995
- 13) Kearney PP, Ramo MP, Shaw TRD, Starkey IR, McMurray JV, Sutherland GR : *Analysis of reproducibility of reference lumen quantitation with intravascular ultrasound in stented coronary arteries. Cathet Cardiovasc Diagn* 40 : 1-7, 1997
- 14) Kuntz RE, Gibson CM, Nobuyoshi M, Baim DS : *Generalized model of restenosis after conventional balloon angioplasty, stenting, and directional atherectomy. J Am Coll Cardiol* 21 : 15-25, 1993
- 15) Post MJ, Borst C, Kuntz RE : *The relative importance of arterial remodeling compared with intimal hyperplasia in lumen renarrowing after balloon angioplasty. Circulation* 89 : 2816-2821, 1994
- 16) Mintz GS, Pichard AD, Kent KM, Salter LF, Popma JJ, Leon MB : *Intravascular ultrasound comparison of restenotic and de novo coronary artery narrowing. Am J Cardiol* 74 : 1278-1280, 1994
- 17) Nakamura S, Colombo A, Gaglione A, Almagor Y, Goldberg SL, Maiello L, Finci L, Tobis JM : *Intracoronary ultrasound observations during stent implantation. Circulation* 89 : 2026-2034, 1994
- 18) Hoffmann R, Mintz GS, Dussailant GR, Popma JJ, Pichard AD, Salter LF, Kent KM, Griffin J, Leon MB : *Patterns and mechanisms of in-stent restenosis. A serial intravascular ultrasound study. Circulation* 94 : 1247-1254, 1996
- 19) Porter TR, Sears T, Xie F, Michels A, Mata J, Welsh D, Shurmur S : *Intravascular ultrasound study of angiographically mildly diseased coronary arteries. J Am Coll Cardiol* 22 : 1858-1865, 1993
- 20) Wolfe CL, Klette MA, Trask RV, Rothbaum DA, Landin RJ, Ball MW, Hodes ZI, Linnemeier TJ : *Assessment of results of percutaneous transluminal coronary angioplasty using an integrated ultrasound imaging-angioplasty catheter.*

- Cathet Cardiovasc Diagn 32 : 108-112, 1994*
- 21) Birgelen C, Kutryk MJB, Gil R, Ozaki Y, Mario C, Roelandt JRTC, Feyter PJ, Serruys PW : *Quantification of the minimal luminal cross-sectional area after coronary*

stenting by two-and three- dimensional intravascular ultrasound versus edge detection and videodensitometry. Am J Cardiol 78 : 520-525, 1996