

급성 심근 경색증 환자에서 일차적 스텐트 시술후 관류지표로서의 Thrombolysis in Myocardial Infarction(TIMI) Frame Count 분석

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Analysis of Angiographic Outcome by Thrombolysis in Myocardial Infarction (TIMI) Frame Count for Primary Stenting in Patients with Acute Myocardial Infarction

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ABSTRACT

Background and Objectives : Primary intervention by stent implantation during acute myocardial infarction is a novel strategy to provide better myocardial perfusion compared to thrombolysis or balloon angioplasty. We aimed to assess the reperfusion achieved by primary stenting, employing TIMI frame count for more objective and quantitative measurement. **Materials and Method :** Measurements for number of frames required to opacify standardized angiographic landmark branch (TIMI frame count) were determined for the coronary arteries of 77 normal controls and 65 patients with acute myocardial infarction who underwent primary stenting within 12 hours of symptom onset. **Results :** In normal subjects, TIMI frame count for left anterior descending artery (LAD) was 1.3 times of mean count of right coronary artery (RCA) and left circumflex artery (LCx), and significant less than that of TIMI study (22.3 ± 4.9 vs 36.2 ± 2.6 , $p < 0.05$). TIMI frame count for RCA and LCx was similar to results of TIMI study. In infarct related arteries (IRA), corrected TIMI frame count (CTFC) after primary stenting was similar to those of normal control. Frame counts of RCA was larger compared to that of normal control, but statistically insignificant (23.0 ± 7.5 vs 17.6 ± 3.5 , $p > 0.05$). There was no difference of CTFC of non-infarct related arteries between patients and normal controls. **Conclusion :** The TIMI frame count of LAD artery in normal Korean subjects was significantly less than that of American counterpart. In patients with acute myocardial infarction, primary stenting appeared to provide improved coronary flow similar to that observed in normal subjects, as measured by TIMI frame counting. **(Korean Circulation J 2000;30(9):1075-1082)**

KEY WORDS : Acute myocardial infarction · Primary stenting · TIMI frame count.

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서론

73%²⁰⁾가 TIMI flow grade 3 이상을 보였다. 그러나 TIMI flow grade 2 이하의 혈류가 27%에 불과하였다. TIMI flow grade 3 이상을 보이는 혈류는 73%에 불과하였다. TIMI flow grade 2 이하의 혈류는 27%에 불과하였다. TIMI flow grade 3 이상을 보이는 혈류는 73%에 불과하였다. TIMI flow grade 2 이하의 혈류는 27%에 불과하였다.

1980년대에는 TIMI frame count가 TIMI flow grade와 함께 TIMI score로 사용되었다. TIMI frame count는 TIMI flow grade와 함께 TIMI score로 사용되었다. TIMI frame count는 TIMI flow grade와 함께 TIMI score로 사용되었다. TIMI frame count는 TIMI flow grade와 함께 TIMI score로 사용되었다.

1982년 Hartzler⁸⁾는 TIMI flow grading²⁴⁾을 TIMI frame count와 함께 TIMI score로 사용하였다. TIMI flow grading²⁴⁾은 TIMI frame count와 함께 TIMI score로 사용하였다. TIMI flow grading²⁴⁾은 TIMI frame count와 함께 TIMI score로 사용하였다. TIMI flow grading²⁴⁾은 TIMI frame count와 함께 TIMI score로 사용하였다.

1998년 3월 12일부터 1999년 6월 12일까지 12명의 연구대상자가 TIMI 3 grade 이상을 보였다. TIMI 3 grade 이상을 보이는 혈류는 95%에 불과하였다. TIMI 3 grade 이상을 보이는 혈류는 95%에 불과하였다. TIMI 3 grade 이상을 보이는 혈류는 95%에 불과하였다. TIMI 3 grade 이상을 보이는 혈류는 95%에 불과하였다.

GUSTO IIb trial에서 TIMI 3 이상을 보이는 혈류는 65%에 불과하였다. TIMI 3 이상을 보이는 혈류는 65%에 불과하였다. TIMI 3 이상을 보이는 혈류는 65%에 불과하였다. TIMI 3 이상을 보이는 혈류는 65%에 불과하였다.

대상 및 방법

연구대상

1998 3 12 - 1999 6 12

12

95%

3

TIMI 3

65

77
ergonovine
(IRA)
TIMI frame count
10%
1)
2)
3)
1 mm ST
3가 2가
ticlopidine
가 3.0 mm
관상 동맥 조영술 및 스텐트 시술
3
Nitroglycerin
30 frame/sec
가
가
2)
가
3)
가
(anterograde flow)
가
7F
the - wire type
monorail system
over -
2
가
TIMI study
(Fig. 1). TIMI frame count



Fig. 1. Examples of landmark branch in coronary arteries. A : Landmark branch of left anterior descending artery ; " whale's tail " appearance. B : Landmark branch of left circumflex artery ; the last branch of obtuse marginal artery in this case. C : Landmark branch of right coronary artery ; the first brach appearing past posterior descending artery.

통계분석

two - tailed t test

p value가 0.05

결 과

대상의 특성

	Controls (n = 77)	Patients (n = 65)
Sex (F/M)	38/39	19/46*
Age (years)	51 ± 12	59 ± 13
Risk factors		
Hypertension	24%	50%*
Diabetes melitus	25%	36%*
Hyperlipidemia	23%	32%
Smoking	23%	32%

* : p<0.05

Table 2. TIMI frame count of control group

	Present study (n = 77)	U.S.A (TIMI4) (n = 78)	p value
LAD	23.3 ± 4.9	36.2 ± 2.6	<0.05
cLAD	17.9 ± 3.7	21.1 ± 1.5	>0.05
LCx	20.8 ± 4.0	22.2 ± 4.1	>0.05
RCA	17.6 ± 3.5	20.4 ± 3.0	>0.05
CTFC	18.3 ± 3.8	21.0 ± 3.1	>0.05

LAD : Left anterior descending artery, LCx : Left circumflex artery RCA : Right coronary artery, CTFC : corrected TIMI frame count

Table 3. TIMI frame count after primary stenting in patients with acute myocardial infarction

	Controls	Patients		p
		IRA	Non-IRA	
cLAD	17.9 ± 3.7 (n = 77)	20.0 ± 5.6 (n = 30)	19.4 ± 7.1 (n = 35)	>0.05
LCx	20.8 ± 4.0 (n = 77)	25.7 ± 10.0 (n = 4)	22.8 ± 8.0 (n = 61)	>0.05
RCA	17.6 ± 3.5 (n = 77)	23.0 ± 7.5 (n = 31)	20.0 ± 7.4 (n = 34)	>0.05
CTFC	18.3 ± 3.8	20.9 ± 7.7	21.2 ± 7.7	>0.05

cLAD : corrected Left anterior descending artery, LCx : Left circumflex artery, RCA : Right coronary artery, CTFC : Corrected TIMI frame count, IRA : infarct related artery

(Table 1).

결 과

TIMI frame count

77 TIMI frame count

가 23.3 ± 4.9 TIMI

36.2 ± 2.6

(p<0.05)

1.3 TIMI frame count

count 20.8 ± 4.0, 17.6 ± 3.5 가

TIMI

1.3

corrected TIMI frame count(CTFC) 18.3 ± 3.0 (Table 2).

일차적 스텐트 시술후의 TIMI frame count

corrected TIMI frame count 20.9 ± 7.7

18.8 ± 3.8

count가

(23.0 ± 7.5 vs 17.6 ± 3.5, p>0.05).

CTFC TIMI frame count (Table 3).

고 찰

TIMI 78
 가 20.4 ± 3.0, 22.2 ± 4.1²¹⁾
 가
 가 frame count TIMI 36.2 ± 2.6
 10 - 12)18) 1.7
 ,²¹⁾
 , 23.3 ± 4.9 ,
 , 1.3
 가 ,²⁶⁾²⁷⁾ corrected TIMI frame
 가 contrast count(CTFC)
 echocardiography²⁶⁾ PET 1.3
²⁷⁾ 가
 가 TIMI
 TIMI 0 3 가 14.7 cm,²⁸⁾ 가 9.8 cm,
 4 TIMI flow 9.3 cm²¹⁾ 1.6
²⁴⁾ monophasic peak
 4가 TIMI flow
 TIMI 2 flow 가 65
²¹⁾ TIMI frame count TIMI frame count CTFC 20.9 ± 7.7
 가 18.3 ± 3.8
 가 TIMI²¹⁾ front loading
 가 tPA 90 CTFC가
²¹⁾ Ivanc²³⁾ 603 가
 3 가 TIMI rescue
 frame count , 0.99 stenting CTFC가 32
 2 frame 21 frame Gibson²⁵⁾
 TIMI frame count front loa -
 30 ding tPA TIMI grade 3 flow
 (tissue perfusion) 60%
 ,³¹⁾ CTFC
 , Rescue ste -
 , 가 가
 , 가 가
 TIMI frame
 count . Gibson²⁵⁾ rescue stent
 77 TIMI frame count 90
 17.6 ± 3.5, 20.8 ± 4.0

CTFC 30.7 ± 16.8, 16.1 ± 6.7 가 가

가 가

29) 가 가

acute gain 가 recoiling 연구배경 :

30) 4

가

Thrombosis in myocardial infarction(TIMI) frame count

(microembolism), 가

가 26)27) CTFC

65

가 77

CTFC가 TIMI 90

CTFC가 21) TIMI frame count

CTFC가 TIMI

결 과 :

77 corrected TIMI frame count

CTFC가 TIMI

nit -

roglycerin 17.6 ± 3.5, 20.8 ± 4.0 TIMI

nitroglycerin 가 (p>0.05). 23.3

± 4.9 TIMI 36.2 ± 2.6

(p<0.05), 1.3

TIMI frame count

CTFC

TIMI frame count

CTFC 가

frame count가 가

가
($p > 0.05$).
결 론 :
TIMI frame
count
TIMI frame count
중심 단어 :
TIMI frame count.

REFERENCES

- 1) DeWood MA, Spores J, Notske R, Mouser LT, Burroughs R, Golden MS, et al. Prevalence of total coronary occlusion during early hours of transmural myocardial infarction. *N Engl J Med* 1980;303:897-902.
- 2) Davis MJ, Thomas AC. Plaque fissuring-the cause of acute myocardial infarction, sudden ischemic death, and crescendo angina. *Br Heart J* 1985;53:363-73.
- 3) Fibrinolytic Therapy Trialists' Group. Indications for fibrinolytic therapy in suspected acute myocardial infarction: Collaborative overview of early mortality and major morbidity results from all randomised trials of more than 1000 patients. *Lancet* 1994;343:311-22.
- 4) Simes RJ, Topol EJ, Holmes DR Jr, White HD, Rutsch WR, Vahanian A, et al. Link between the angiographic substudy and mortality outcomes in a large randomized trial of myocardial reperfusion. Importance of early and complete infarct artery reperfusion. *Circulation* 1995;91:1923-8.
- 5) GUSTO Angiographic Investigators. The effect of tissue plasminogen activator, streptokinase, or both on coronary-artery patency, ventricular function, and survival after acute myocardial infarction. *N Engl J Med* 1993;329:1615-1622.
- 6) Meijer A, Verheugt FWA, Werter CPJP, Lie KI, van der Pol JM, van Eenige MJ. Aspirin versus coumadine in the prevention of reocclusion and recurrent ischemia after successful thrombolysis: A prospective placebo-controlled angiographic study. *Circulation* 1993;87:1524-30.
- 7) Chesebro JH, Knatterud G, Roberts R, Borer J, Cohen LS, Dalen J, et al. Thrombolysis in Myocardial Infarction (TIMI) trial, Phase I: A comparison between intravenous tissue plasminogen activator and intravenous streptokinase. *Circulation* 1987;76:142-54.
- 8) Hartzler GO, Rutherford BD, McConahay DR, Johnson WL Jr, McCallister BD, Gura GM Jr, et al. Percutaneous transluminal coronary angioplasty with and without thrombolytic therapy for treatment of acute myocardial infarction. *Am Heart J* 1983;106:965-73.
- 9) Topol EJ, Califf RM, George BS, Kereiakes DJ, Abbot-Smith CW, Candela RJ, et al. A randomized trial of Immediate versus delayed elective angioplasty after intravenous tissue plasminogen activator in acute myocardial infarction. *N Engl J Med* 1987;317:581-8.
- 10) Simoons ML, Arnold AER, Betriu A, de Bono DP, Col J, Dougherty FC, et al. Thrombolysis with t-PA in acute myocardial infarction: No beneficial effects of immediate PTCA. *Lancet* 1988;1:197-203.
- 11) The TIMI Study Group. Comparison of invasive and conservative strategies following intravenous tissue plasminogen activator in acute myocardial infarction. Results of the Thrombolysis in Myocardial Infarction (TIMI) II trial. *N Engl J Med* 1989;320:618-28.
- 12) Grines CL, Browne KR, Marco J, Rothbaum D, Stone GW, O'Keefe J, et al. A comparison of primary angioplasty with thrombolytic therapy for acute myocardial infarction. *N Engl J Med* 1993;328:673-9.
- 13) Zijlstra F, DeBoer MJ, Hoorntje JCA, Reijnders S, Reiber JH, Suryapranata H, et al. A comparison of immediate angioplasty with intravenous streptokinase in acute myocardial infarction. *N Engl J Med* 1993;328:680-4.
- 14) Gibbons RJ, Holmes DR, Reeder GS, Bailey KR, Hopfenspirger MR, GERsh BJ, et al. Immediate angioplasty compared with the administration of a thrombolytic agent followed by conservative treatment for myocardial infarction. *N Engl J Med* 1993;328:685-91.
- 15) O'Neill WW, Brodie BR, Ivanhoe R, Knopf W, Taylor G, O'Keefe J, et al. Primary angioplasty for acute myocardial infarction. *Am J Cardiol* 1994;73:627-34.
- 16) Rodriguez AE, Bernardi V, Fernandez M, Mauvecin C, Ayala F, Santera O, et al. In-hospital and late results of coronary stents versus conventional balloon angioplasty in acute myocardial infarction (GRAMI trial). *Am J Cardiol* 1998;81:1286-91.
- 17) Antoniucci D, Santoro GM, Bolognese L, Valenti R, Trapani M, Fazzini PF. A clinical trial comparing primary stenting of the infarct-related artery with optimal primary angioplasty for acute myocardial infarction. Results from the Florence Randomized Elective Stenting in Acute Coronary Occlusions (FRESCO) Trial. *J Am Coll Cardiol* 1998;31:1234-9.
- 18) Suryapranata H, Van't Hof AWJ, Hoorntje JCA, de Boer MJ, Zijlstra F. Randomized comparison of coronary stenting with balloon angioplasty in selective patients with acute myocardial infarction. *Circulation* 1998;97:2502-5.
- 19) Stone GW, Brodie BR, Griffin JJ, Morice MC, Costantini C, St Goar FG, et al. Prospective, multicenter study of the safety and feasibility of primary stenting in acute myocardial infarction: In-hospital and 30 days results of the PAMI stent pilot trial. *J Am Coll Cardiol* 1998;31:23-30.
- 20) The GUSTO II Investigators. A clinical trial comparing primary coronary angioplasty with tissue plasminogen activator for acute myocardial infarction. *N Engl J Med* 1997;336:1621-28.
- 21) Gibson CM, Cannon CP, Daley WL, Dodge JT jr, Alexander B Jr, Marble SJ, et al. TIMI frame count. A quantitative method of assessing coronary flow. *Circulation* 1996;93:879-88.
- 22) Dodge JT, Rizzo M, Nykiel M, Altmann J, Hobkirk K, Brennan M, et al. Impact of injection rate on the Thrombolysis in Myocardial Infarction (TIMI) trial frame count. *Am J Cardiol* 1998;81:1268-70.
- 23) Ivanc TB, Crowe TD, Balazs EM, Debowey DL, Ellis

- SG. Reproducibility of the corrected TIMI frame count in angiograms of MI patients receiving thrombolysis. *J Am Coll Cardiol* 1998;31:11A.
- 24) The TIMI Study Group. *The Thrombolysis in Myocardial Infarction (TIMI) trial. N Engl J Med* 1985;312:932-6.
 - 25) Gibson M, Rizzo MJ, McLean C, Sparano AM, Ryan K, Moynihan J, et al. Adjunctive stenting following thrombolysis in TIMI 10A and B. *Circulation* 1997;96:1-328.
 - 26) Ito H, Tomooka T, Sakai N, Yu H, Higashino Y, Fujii K, et al. Lack of myocardial perfusion immediately after successful thrombolysis. *Circulation* 1992;85:1699-1705.
 - 27) Maes A, Van de Werf F, Nuyts J, Bormans G, Desmet W, Mortelmans L. Impaired myocardial tissue perfusion early after successful thrombolysis. Impact on myocardial flow, metabolism, and function at late follow up. *Circulation* 1995;92:2072-8.
 - 28) Dodge JT, Brown BG, Bolson EL, Dodge HT. Intrathoracic spatial location of specified coronary segments on the normal human heart: Applications in quantitative arteriography, assessment of regional risk and contraction, and anatomic display. *Circulation* 1998;78:1167-80.
 - 29) Edep ME, Guarneri EM, Teirstein PS, Phillips PS, Brown DL. Difference in TIMI frame count following successful reperfusion with stenting or percutaneous transluminal coronary angioplasty for acute myocardial infarction. *Am J Cardiol* 1999;83:1326-9.
 - 30) Garcia-Cantu E, Spaulding C, Thierry C, Khaldoun BH, Roussel L, Favereau X, et al. Stent implantaion in acute myocardial infarction. *Am J Cardiol* 1996;77:451-4.
 - 31) Gibson CM, Goel M, Ryan K, Rizzo M, Marble SJ. Insight into the pathophysiology of acute coronary syndromes using the TIMI flow grade and TIMI frame counting methods. In: Cannon CP editor. *Management of acute coronary syndromes Totowa: Humana Press;1999. p.87-107.*