

Percutaneous revascularization of total or subtotal left main occlusion in the setting of acute myocardial infarction

Akut miyokart enfarktüsünde total ya da subtotal sol ana koroner tıkanıklığının perkütan revaskülarizasyonu

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ABSTRACT

Objectives: We evaluated the effect of percutaneous coronary intervention (PCI) for total or subtotal left main coronary occlusion (LMCO) in the setting of acute myocardial infarction (AMI), together with clinical features, outcome, and prognostic determinants.

Study design: Between March 2008 and June 2010, PCI was performed for total or subtotal thrombotic LMCO in eight patients with AMI. All the patients were males with a mean age of 55.5 years (range 25 to 75 years). The primary endpoints were the occurrence of major adverse cardiac events including death from any cause, nonfatal myocardial infarction, and target lesion revascularization.

Results: Five patients were admitted with anterior AMI and three patients with non-ST elevation AMI. Seven patients were in cardiogenic shock. The mean symptom duration was 195 min (range 15 min to 10 hr). Predilatation was performed in six patients, and postdilatation was performed in two patients. Six patients received a single stent with the cross-over technique and the simultaneous kissing stent technique was used in one patient. Mortality occurred in three patients (37.5%). Two deaths developed in the catheterization laboratory, one before stent implantation. One patient died six days after the procedure due to subacute stent thrombosis. After a mean follow-up of 79 weeks (range 27 to 152 weeks), two patients underwent elective bypass surgery because of restenosis, while the rest of the patients remained free of any cardiac event.

Conclusion: Percutaneous coronary intervention in patients with LMCO complicated by AMI is feasible and effective, and offers a good mid-term outcome for hospital survivors.

ÖZET

Amaç: Bu çalışmada, akut miyokart enfarktüsü (AME) tablosunda total ya da subtotal sol ana koroner tıkanıklığına (SAKT) uygulanan perkütan koroner girişimin (PKG) etkinliği, SAKT'nin klinik özellikleri, tedavi sonuçları ve prognostik belirteçleri değerlendirildi.

Çalışma planı: 2008 Mart ile Haziran 2010 tarihleri arasında, total ya da subtotal trombotik SAKT'li sekiz AME hastasına PKG uygulandı. Tümü erkek olan hastalarda ortalama yaş 55.5 (dağılım 25-75) idi. Değerlendirmede önemli kardiyak olaylar (her türlü nedenden ölüm, ölümlerle sonuçlanmayan miyokart enfarktüsü ve hedef lezyon revaskülarizasyonu) birincil sonlanım noktası olarak kabul edildi.

Bulgular: Beş hasta akut ön duvar miyokart enfarktüsü, üç hasta ise ST yükselmesiz miyokart enfarktüsü tanıları ile yatırılmıştı. Yedi hasta akut kardiyojenik şok içindeydi. Ortalama semptom süresi 195 dk (dağılım 15 dk-10 sa) idi. Altı hastada predilatasyon, iki hastada postdilatasyon uygulandı. Altı hastada tek stentle "cross-over" tekniği kullanılırken, bir hastada "kissing" stent tekniği kullanıldı. Ölüm üç hastada (%37.5) gelişti. Biri stent yerleştirme öncesinde olmak üzere, iki hasta kateterizasyon laboratuvarında kaybedildi. Bir hasta ise, işlemden altı gün sonra subakut stent trombozundan öldü. Ortalama 79 haftalık izlem döneminde (dağılım 27-152 hafta), iki hasta tekrarlayan darlık nedeniyle baypas olurken, geri kalan hastalarda herhangi bir kardiyak olay gözlenmedi.

Sonuç: Perkütan koroner revaskülarizasyon AME ile kendini gösteren SAKT'de uygulanabilir etkili bir tedavi stratejisidir ve taburcu edilebilen hastalara iyi bir orta dönem prognozu sağlar.

Received: May 20, 2011 Accepted: September 6, 2011

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The prevalence of left main coronary occlusion following acute myocardial infarction is 1.5% in angiographic studies.^[1] It has a high mortality and morbidity rate. The left main coronary artery supplies blood to the vast majority of the left ventricular myocardium, and pump failure and refractory ventricular arrhythmias are the main causes of death following acute LMCO. The number of patients in published studies undergoing revascularization procedures, however, is low.

In this study, we evaluated the outcomes of emergency percutaneous coronary intervention in eight cases of acute myocardial infarction involving an unprotected total or subtotal acute LMCO.

PATIENTS AND METHODS

From March 2008 to June 2010, 2,000 patients underwent primary PCI in two hospitals. Of these, eight patients who had primary PCI for total or subtotal occlusion of the LMCA presenting with a TIMI flow grade of less than 3 on coronary angiography were included in the study. Data were obtained from review of institutional databases, folder auditing, telephone survey of the patients, and review of angiograms. The study protocol was approved by the institutional ethics committee.

Definitions

Patients were diagnosed with ST-segment elevation acute myocardial infarction when they had 1 mm or more new or presumably new ST-segment elevation seen in any location on the index or subsequent electrocardiogram with at least one positive cardiac biochemical marker of necrosis (including troponin measurements, whether qualitative or quantitative). In cases of non-STEMI (without ST elevation), the presence of at least one positive cardiac biochemical marker of necrosis without new ST elevation on the index or subsequent electrocardiogram was considered. Cardiogenic shock was defined as the persistence of systolic blood pressure below 90 mmHg. The Killip classification system was used to assess heart failure.

Primary stenting procedure

Stents were deployed according to the standard techniques. Heparin was given as an initial bolus of 10,000 U at the beginning of the procedure, and clopidogrel and aspirin were given to all the patients. A glycoprotein IIb/IIIa inhibitor, tirofiban, was administered at the discretion of the interventional cardiologist. All

patients were put on lifelong clopidogrel and aspirin treatment after discharge.

Angiographic analysis

Collateral vessels were graded according to the Rentrop classification, and anterograde flow was measured using the TIMI flow scale. Angiographic success was defined as the presence of <30% residual stenosis and TIMI 3 flow. Significant coronary disease was defined as the present of at least 50% luminal diameter narrowing.

In-hospital events and follow-up

In-hospital complications included death, reinfarction, and emergency coronary artery bypass graft surgery. Follow-up was carried out via telephone surveys of the patients following discharge. If a patient could not be contacted, the next of kin and family doctors were contacted to obtain follow-up data. Major adverse cardiac events included death from any cause, nonfatal myocardial infarction, and target lesion revascularization.

RESULTS

All the patients were males with a mean age of 55.5 years (range 25 to 75 years). Five patients (62.5%) were smokers. Two had diabetes, four had hyperlipidemia, and one patient had hypertension (Table 1). Five patients had anterior ST-segment elevation (Fig. 1a), while three had ST-segment depression. The mean symptom duration was 195 min (range 15 min to 10 hr). One patient had a history of myocardial infarction, and two patients had undergone coronary stent implantation. Cardiogenic shock was a common presentation (87.5%). Four patients received intra-aortic balloon pump and three received mechanical ventilation. Tirofiban was given to five patients.

Angiographic findings are listed in Table 1. One patient had chronic total occlusion of the mid-segment of the left anterior descending artery. Predilatation was performed in six patients, and postdilatation was performed in two patients. A single bare metal stent was used with a cross-over technique in six patients, and the simultaneous kissing stent technique was used in one patient. TIMI 3 flow was achieved in six patients (75%) (Fig. 1b, c).

Abbreviations:

CABG	Coronary artery bypass graft surgery
LAD	Left anterior descending
LMCA	Left main coronary artery
LMCO	Left main coronary occlusion
PCI	Percutaneous coronary intervention
STEMI	ST-segment elevation acute myocardial infarction

Table 1. Baseline clinical characteristics, angiographic, procedural, and follow-up data of the patients (all males)

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8*
Age (years)	55	75	51	25	48	54	66	70
Diabetes mellitus	–	–	+	–	–	–	+	–
Hypertension	–	–	–	–	–	–	–	+
Hyperlipidemia	–	–	+	–	+	–	+	+
Smoking	+	–	+	+	+	–	–	+
Symptom duration	2 hr	4 hr	2 hr	15 min	2 hr	10 hr	2 hr	10 hr
Cardiogenic shock	+	+	+	+	–	+	+	+
Localization of myocardial infarction	Anterior	Anterior	Anterior	Anterior	Non-STEMI	Anterior	Non-STEMI	Non-STEMI
Angiographic and procedural data								
Lesion site	Distal	Shaft	Shaft	Distal	Distal	Distal	Distal	Distal
LAD TIMI flow	1	0	0	0	0	0	1	0
Cx TIMI flow	3	0	0	0	3	3	1	0
RCA stenosis (>50%)	–	+	–	+	+	+	+	?
Rentrop classification	1	0	1	0	2	0	0	?
Tirofiban	+	+	–	+	+	+	–	–
Resuscitation in catheter lab	–	–	+	–	–	–	+	+
Intra-aortic balloon pump	–	+	–	–	+	+	+	–
Predilatation	+	–	+	–	+	+	+	+
Postdilatation	+	–	–	+	–	–	–	–
Postintervention LAD TIMI flow	3	3	2	3	0	2	3	2
Postintervention Cx TIMI flow	3	0	3	3	3	3	3	2
Successful procedure	+	+	–	+	+	+	+	–
One stent	+	+	–	+	+	+	+	NA
Kissing stent	–	–	+	–	–	–	–	–
Mortality	–	Hospital	Lab	–	–	–	–	Lab
Restenosis	–	NA	NA	+	+	–	–	NA
Follow up (weeks)	67	NA	NA	152	78	71	27	NA

*Case 8 was continuously resuscitated before and during the procedure. The operator proceeded with percutaneous coronary intervention for left main occlusion without angiogram of the RCA. STEMI: ST elevation acute myocardial infarction; LAD: Left anterior descending artery; Cx: Circumflex artery; RCA: Right coronary artery; NA: Not available.

Mortality occurred in three patients (37.5%). Two deaths developed in the catheterization laboratory, one of which occurred before a stent could be deployed. One patient died six days after the procedure due to subacute stent thrombosis. The remaining five patients (62.5%) were discharged in good condition.

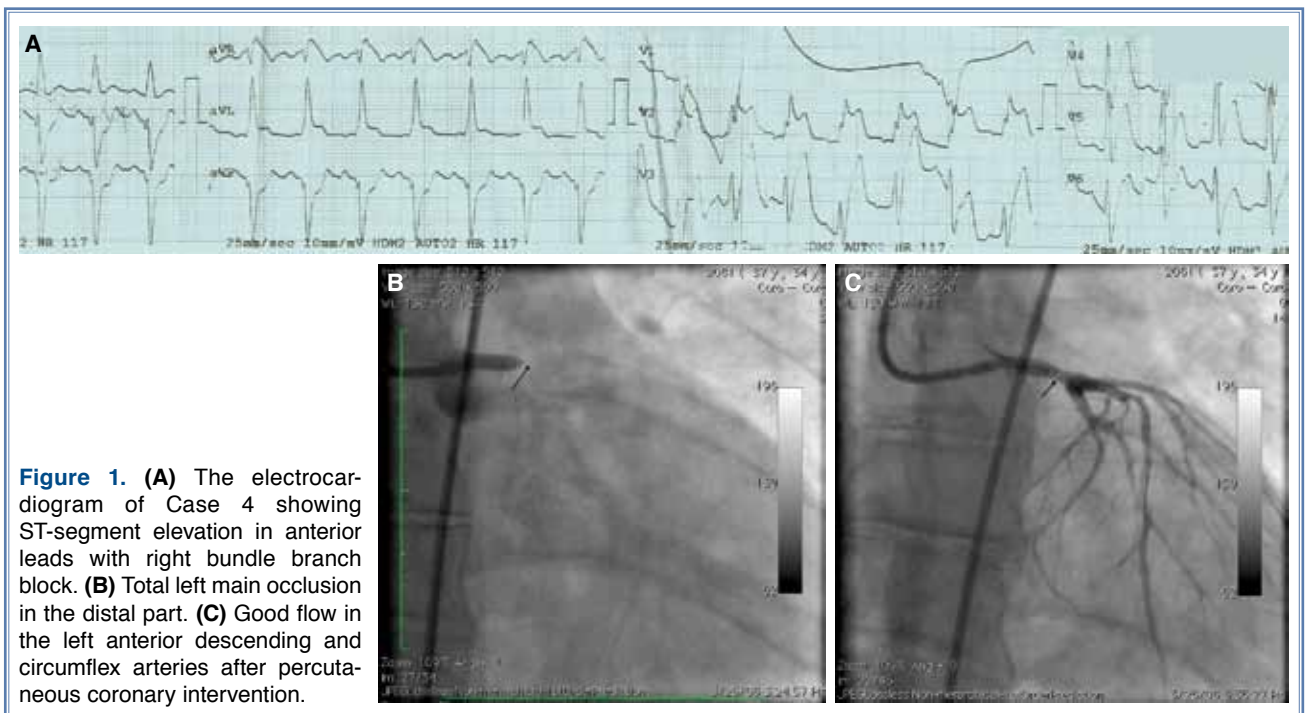
The mean symptom duration was longer (320 vs. 195 min) and the mean age was higher (65.3 vs. 49.6 years) in the mortality group compared to survivors. Of seven patients presenting with cardiogenic shock, mortality occurred in three.

Two survivors underwent elective CABG at two and four months after the initial procedure, respec-

tively, due to restenosis, and the remaining survivors had no further major cardiac events over an average of 79 weeks of follow-up (range 27 to 152 weeks).

DISCUSSION

Acute left main coronary occlusion is a rare but serious condition, and data are limited on the clinical outcomes of patients undergoing primary PCI for LMCO. Moreover, comparisons between studies are difficult due to critical differences between these series in baseline patient characteristics, LMCO severity, and PCI techniques (Table 2).^[1-14] The incidence



in the present study (0.4%) was lower than reported in previous series. The study hospitals serve large areas and this may contribute to prehospital delays, resulting in increased out-of-hospital mortality and thus lower incidence. Furthermore, in the present study, we only included patients with a less frequent representation, i.e., those with acute myocardial infarction with and without ST elevation and with unprotected total or subtotal LMCO. In a relatively large trial, when the LMCA was the infarct-related artery, only 20% of patients had a flow grade of less than TIMI 3.^[2]

Acute left main coronary occlusion can present as sudden cardiac death, acute coronary syndrome, or cardiogenic shock, and acute myocardial infarction related to LMCO can present as non-STEMI or STEMI. In the ULTIMA study, 24 patients (70.5%) had ST elevation in two contiguous leads, three patients (9%) had anterolateral ST depression, three patients (9%) had left bundle branch block, and four patients (12%) had no ST-segment deviation.^[3] Chia et al.^[4] studied 20 patients with LMCO and found that 55% had STEMI. In the present study, five patients (62.5%) had anterior myocardial infarction, and the remaining three had non-STEMI.

Cardiogenic shock, postprocedural TIMI flow grade, and absent or diminished collaterals have been linked to patient mortality.^[5-7] Sakai et al.^[6] found higher in-hospital mortality, lower success-

ful PCI procedure, and lower one-year mortality rates in patients with cardiogenic shock compared to non-shock patients. In the present study, seven patients were in cardiogenic shock (87.5%), and the mortality rate was 42.9% in patients having cardiogenic shock. Furthermore, all deaths occurred in those with cardiogenic shock. All patients in the present study had total or subtotal occlusion in the LAD, perhaps leading to a higher incidence of cardiogenic shock. Sakai et al.^[6] reported a higher incidence of collateral flow (Rentrop grade 2 or 3) to the infarcted area and a dominant RCA in survivors compared to nonsurvivors, though these differences did not reach statistical significance. In the present study, one patient who did not suffer from cardiogenic shock had Rentrop grade 2 collaterals and was discharged in good condition. This patient had chronic total occlusion of the mid-segment of the LAD, and such chronic ischemia may have induced collateral development.

The goal of management in acute myocardial infarction is to achieve restoration of the blood flow quickly, and previous studies have shown better results with mechanical revascularization compared to thrombolytic therapy.^[15,16] Mechanical treatment options include surgical and percutaneous revascularization. Both procedures carry high risk, particularly in patients with cardiogenic shock. Two initial studies reported 83% and 100% mortality rates for PCI,

Table 2. Literature reports on percutaneous coronary intervention of the left main coronary occlusion (LMCO)

	Time period	No. of cohort	No. of patients	Frequency of LMCO	Cardiogenic shock	IABP	GpIIb/IIIa	LMCO	Clinical status	In-hospital mortality
Neri et al. ^[1]	1995-2000	1433	22	1.5%	18 (81.8%)	18 (81.8%)	10 (45.5%)	IRA	STEMI	50%
Lee et al. ^[2]	2002-2006	NA	62	NA	15 (24.2%)	15 (24.2%)	22 (35%)	IRA	STEMI, non-STEMI	8%
Marso et al. ^[3]	1994-1996	277	40	14%	37 (92.5%)	35 (87.5%)	NA	>80%	STEMI, non-STEMI	55%
Chia et al. ^[4]	2002-2007	540	20	3.7%	16 (80%)	20 (100%)	NA	Total or subtotal	STEMI, non-STEMI	65%
De Luca et al. ^[5]	1990-2001	2800	24	0.9%	15 (62.5%)	24 (100%)	5 (20.8%)	Total or subtotal	STEMI	58%
Sakai et al. ^[6]	1992-2000	1736	38	2.2%	28 (73.7%)	38 (100%)	NA	Total or subtotal	Acute anterolateral MI	55%
Yip et al. ^[7]	1993-2000	740	18	2.4%	14 (77.8%)	17 (94.4%)	NA	>80%	STEMI	33%
Hurtado et al. ^[8]	1999-2007	NA	71	NA	47 (66.2%)	38 (53.5%)	NA	>50%	STEMI, non-STEMI	47%
Tang et al. ^[9]	2000-2005	1539	11	0.7%	9 (81.8%)	11 (100%)	NA	Total or subtotal	STEMI, non-STEMI	82%
Valeur et al. ^[10]	2000-2003	715	12	1.7%	10 (83.3%)	9 (75%)	5 (41.7%)	Total or subtotal	STEMI, non-STEMI	58%
Prasad et al. ^[11]	2004-2007	1115	28	2.5%	18 (64.3%)	15 (53.6%)	15 (53.6%)	>70%	STEMI	36%
Lee et al. ^[12]	1997-2002	332	18	5.4%	14 (77.8%)	14 (77.8%)	12 (66.7%)	IRA	STEMI	44%
Tan et al. ^[13]	2003-2005	NA	16	NA	11 (68.8%)	11 (68.8%)	NA	IRA	STEMI	44%
Ghrissi et al. ^[14]	2002-2009	746	6	0.8%	5 (83.3%)	5 (83.3%)	1 (16.7%)	Total or subtotal	STEMI, non-STEMI	66%
Karabay et al.	2008-2010	2000	8	0.4%	7 (87.5%)	4 (50%)	4 (50%)	Total or subtotal	STEMI, non-STEMI	37.5%

IABP: Intra-aortic balloon pump; IRA: Infarct-related artery; NA: Not available; STEMI: ST-segment elevation myocardial infarction; Shock: Blood pressure <90 mmHg.

respectively, in patients with LMCO.^[17,18] More recent studies also showed very high mortality rates, with the exception of Yip et al.^[7] who reported 33%, which is comparable to the present study (Table 2). These findings show that the prognosis of patients undergoing PCI for LMCO is still unfavorable. With regard to surgical treatment, Nakanishi et al.^[19] reported results of 70 patients with acute myocardial infarction who underwent CABG. The overall mortality rate was 40%, but increased to 46% in patients with LMCA stenosis and to 53% in patients with cardiogenic shock. None of the patients in the present study underwent CABG due to time limitations.

The long-term prognosis of LMCO is relatively favorable in terms of major cardiac events.^[6-8] Yip et al.^[7] reported a long-term survival rate of 83% for in-hospital survivors; Hurtado et al.^[8] reported 47% in-hospital and 10% out-of-hospital mortality rates in the first year following LMCO; and Sakai et al.^[6] reported an in-hospital mortality rate of 10% and one-year mortality rate of 20% in stable patients, which they considered acceptable. In the present study, none of the patients who were discharged in good condition developed cardiac death over a mean follow-up period of 79 weeks. This result is comparable to other studies reporting low mortality rates among hospital

survivors, ranging from 8% to 17%.^[5,7] Two of the five survivors (40%) in the present study underwent CABG at two and four months after the initial procedure, respectively.

Limitations

This was a retrospective, nonrandomized study with a small sample size. However, most reports on LMCO involve small subgroups from larger cohorts of patients undergoing PCI. Bare metal stents were used and this may increase restenosis rate. Routine follow-up angiography was not performed.

In conclusion, acute left main coronary occlusion is a rare but serious condition, and cardiogenic shock is a common presentation related to patient mortality. Successful primary PCI resulting in TIMI 3 flow in the LAD and circumflex arteries can decrease mortality rates, and patients who survive the initial event, including those with cardiogenic shock, may have a good mid-term prognosis with PCI. As the survival benefit of primary PCI outweighs the risk, it should be performed in patients with acute LMCO.

Conflict-of-interest issues regarding the authorship or article: None declared

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Key words: Angioplasty, balloon, coronary; coronary angiography; coronary artery disease/therapy; coronary occlusion/complications; myocardial infarction/complications/therapy; stents.

Anahtar sözcükler: Anjiyoplasti, balon, koroner; koroner anjiyografi; koroner arter hastalığı/televi; koroner tıkanıklık; miyokart enfarktüsü/komplikasyon/televi; stent.