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Impact of Chronic Kidney Disease on Left Main Coronary Artery Disease and Prognosis in Japanese Patients

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Background: Renal insufficiency plays a critical role in the pathogenesis of ischemic heart disease. The aim of the present study was to investigate the prevalence of renal dysfunction and its impact on prognosis in patients with left main coronary artery disease (LMCAD) and stable angina pectoris.

Methods and Results: A total of 626 consecutive patients with significant coronary artery stenosis were enrolled. Renal insufficiency was graded using estimated glomerular filtration rate (eGFR) before coronary angiography. Chronic kidney disease (CKD) was defined as eGFR <60 ml·min^{-1}·1.73 m^{-2} and/or proteinuria. Patients with LMCAD (n=95) had a significantly higher prevalence of CKD than those without LMCAD (P=0.02). Multiple logistic regression analysis showed that CKD was independently associated with LMCAD (adjusted odds ratio, 1.74; 95% confidence interval [CI]: 1.09–2.76, P=0.01). A 1-year follow-up of patients with LMCAD showed that the cumulative incidence of major adverse cardiovascular events among patients with eGFR <30 ml·min^{-1}·1.73 m^{-2} was higher than that among patients with eGFR ≥60 ml·min^{-1}·1.73 m^{-2} (P=0.03). The hazard ratio for a cardiovascular event was 9.54 (95% CI: 3.15–28.89, P<0.01) when comparing patients with LMCAD and eGFR <30 ml·min^{-1}·1.73 m^{-2} vs. patients without LMCAD and eGFR ≥60 ml·min^{-1}·1.73 m^{-2}.

Conclusions: Renal insufficiency is a risk factor for LMCAD and predicts poor prognosis in Japanese patients. (*Circ J* 2012; **76:** 2266–2272)

Key Words: Chronic kidney disease; Coronary artery disease; Left main coronary artery; Risk factor

Obstructive disease of the left main coronary artery (LMCAD) is associated with poor prognosis.[1] Previous studies have sought to identify clinical characteristics linked to LMCAD, but those studies demonstrated only that patients with LMCAD have clinical features associated with diffuse, multi-vessel, coronary artery disease, and clinical features specific to LMCAD were not identified.[2–4]

In addition to the major traditional risk factors for cardiovascular disease (ie, advanced age, hypertension, diabetes mellitus, dyslipidemia, and smoking), recent studies suggest that chronic kidney disease (CKD) is an independent risk factor.[5] Several groups have reported that coronary artery disease severity and lesion complexity are associated with a decrease in the estimated glomerular filtration rate (eGFR).[6,7] Recent epidemiological studies and clinical trials have demonstrated that CKD is associated with increased mortality rate in patients with cardiovascular disease.[8,9] Extremely poor outcomes have been reported for patients with cardiovascular disease and CKD who were treated with percutaneous coronary intervention (PCI).[10–12] Although coronary artery bypass grafting (CABG) was an established therapy for patients with LMCAD, recent studies showed that the use of a coronary stent has made it feasible to treat LMCAD using PCI.[13] The decreased risk of periprocedural mortality after cardiac catheterization may improve outcomes for patients with LMCAD. The impact of CKD on the prognosis of patients with LMCAD has not been fully elucidated, however.

In the present study, we investigated whether CKD is an important risk factor for LMCAD, as detected on coronary angiography. In addition, we investigated whether the severity of renal dysfunction affects the prognosis of patients with LMCAD after optimal initial treatment.

Methods

Subjects

Between February 2006 and March 2009, we registered 1,601

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consecutive patients who underwent coronary angiography at Mitoyo General Hospital, Kagawa, Japan. Patients with significant stenosis of at least 1 epicardial coronary artery were enrolled in the study. Patients with acute coronary syndrome, cardiogenic shock, valvular heart disease, or cardiomyopathy were excluded. The final analysis involved 626 patients with stable angina pectoris who had significant stenosis of at least 1 epicardial coronary artery. Twenty subjects who had stenosis <25% luminal reduction in all coronary arteries were defined as the control group after angiography due to suspected CAD. Written, informed consent for study participation was obtained from each patient, in accordance with the Helsinki declaration, and the study was approved by the Institutional Ethics Committee.

Protocols

Protocol 1 The patients were separated according to an angiographic assessment as having LMCAD (LMCAD group) or not having LMCAD (non-LMCAD group). This study examined the relationship between the presence of LMCAD and the eGFR values and traditional coronary risk factors.

Protocol 2 The patients who were able to be followed up after discharge were reassigned according to eGFR and the presence or absence of LMCAD. Outcome of primary interest in protocol 2 was the incidence of subsequent major adverse cardiovascular and cerebrovascular events (MACCE).

Cardiac Catheterization

Significant stenosis was defined as >50% luminal reduction in the left main trunk and >75% luminal reduction in the left anterior descending, left circumflex, or right coronary artery. Control subjects were defined as having stenosis <25% luminal reduction in all coronary arteries. The subjects with significant stenosis were categorized into 2 groups on the basis of the presence of significant stenosis in left main trunk; LMCAD group; and non-LMCAD group. Each coronary angiogram was analyzed using the automated edge-detection system or by careful visual inspection by at least 2 cardiologists with expertise in coronary catheter intervention.

Blood Sampling

Blood samples were collected from fasting patients early in the morning on the day of coronary angiography. Concentration of serum lipids was measured using automated enzymatic methods.[14] Concentration of low-density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald equation.[15] Hemoglobin A_{1c} was expressed in units as defined by the Japan Diabetic Society (JDS).[16] Serum creatinine was measured automatically using an enzyme assay. Plasma concentration of polyunsaturated fatty acids (ie, arachidonic acid [AA] and eicosapentaenoic acid [EPA]) was measured using capillary gas chromatography as described previously.[17]

Definition of Risk Factors

Diabetes mellitus was defined as the presence of any of the following: fasting plasma glucose levels ≥126 mg/dl; casual plasma glucose levels ≥200 mg/dl; or a history of treatment for diabetes mellitus. Hypertension was confirmed if any of the following criteria were met: systolic blood pressure ≥140 mmHg; diastolic blood pressure ≥90 mmHg; or the current use of antihypertensive agents. Dyslipidemia was defined as the use of lipid-lowering agents or if one or more of the following criteria from the first fasting blood sample were met: LDL-C ≥140 mg/dl; triglyceride ≥150 mg/dl; or high-density lipoprotein cholesterol (HDL-C) <40 mg/dl. eGFR was calculated using the equation from the Modification of Diet in Renal Disease Study Group,[18] with coefficients modified for Japanese patients:[19] $\text{eGFR}\ (\text{ml}\cdot\text{min}^{-1}\cdot 1.73\,\text{m}^{-2}) = 194 \times \text{serum creatinine}^{-1.094} \times \text{age}^{-0.287} \times [0.739\ \text{if female}]$. CKD was defined as eGFR <60 $\text{ml}\cdot\text{min}^{-1}\cdot 1.73\,\text{m}^{-2}$ and/or proteinuria.

Definition of MACCE

The treatment that was finally performed on de novo lesions in all patients was considered to be the initial treatment. The initial treatment was defined as medical therapy alone, initial successful PCI, or initial CABG. MACCE was defined as one of the following conditions: revascularization due to new or recurrent fatal and non-fatal acute myocardial infarction; new or recurrent unstable angina pectoris; and de novo stable lesion and target lesion restenosis; heart failure admission; stroke and transient ischemic attack; cardiac death.

Statistical Analysis

Statistical analysis was performed using SPSS 11.0 for Windows (SPSS, Chicago, IL, USA). Data that were not distributed normally, as determined using the Kolmogorov-Smirnov test, were logarithmically transformed before analysis. Continuous variables were compared using unpaired Student's t-test or 1-way analysis of variance. These data are presented as mean±SD. Categorical variables were compared using either chi-square test or Fisher's exact test and are expressed as frequencies with percentages. Multivariate multiple logistic regression was used to detect associations between LMCAD and various risk factors including CKD, age, male gender, diabetes mellitus, hypertension, dyslipidemia, and smoking. MACCE event time was defined as the time between discharge from hospital after the procedure and the occurrence of the first MACCE. Cumulative MACCE-free survival rates were estimated using the Kaplan-Meier method and represented patients who did not experience MACCE over the 1-year follow-up period. Survival rates were compared among groups using the log-rank test. The association with MACCE was assessed using a multivariate Cox proportional hazards model. Group differences associated with $P<0.05$ were considered statistically significant.

Results

Protocol 1

Renal Dysfunction and LMCAD Patient characteristics and laboratory values are summarized in Table 1. Among 625 patients with stable angina pectoris, 95 (15%) were found to have LMCAD. Conventional risk factors for coronary artery disease were examined among 3 groups: control; non-LMCAD; and LMCAD. The percentage of elderly subjects, male subjects, subjects with dyslipidemia, and smokers was higher in the LMCAD group than in the control group. Except for dyslipidemia, the frequency of these factors did not differ between the LMCAD and non-LMCAD groups. With regard to biochemistry parameters (ie, lipid profiles and glucose metabolism), patients with LMCAD had significantly lower levels of HDL-C than the control subjects. HDL-C level did not differ, however, between patients with and without LMCAD. AA/EPA and B-type natriuretic peptide level also did not differ between patients with and without LMCAD. eGFR was highest in the control group and was decreased significantly in non-LMCAD patients. Patients with LMCAD, however, had the greatest reduction in kidney function. As such, both eGFR and the prevalence of dyslipidemia differed between patients with and without LMCAD (both the control and non-LMCAD groups). In addition, when patients with stable angina were classified into

Table 1. Patient Characteristics

	Controls (n=20)	Non-LMCAD			LMCAD (n=95)
		Total (n=531)	Single-vessel (n=314)	Multi-vessel (n=217)	
Age (years)	65±11	69±10	69±11	69±10	71±9*
Male (%)	45	75*	75	74	71*
Hypertension (%)	55	67	62	73	74
Diabetes mellitus (%)	15	24	21	27	22
Dyslipidemia (%)	26	31	27	36	51*,†
Smoking (%)	20	55*	56	54	50*
eGFR ($ml \cdot min^{-1} \cdot 1.73 m^{-2}$)	79±25	63±22*	65±20	60±24	54±25*,#
eGFR ≥60 (%)	75	55	58	52	43
30≤eGFR<60 (%)	20	38	38	38	41
eGFR <30 (%)	5	7	4	10	16
Proteinuria (%)	0	8	5	12	17*,†
CKD (%)	25	45*	42	49	58*,†
Hemodialysis (%)	0	3	1	5	9†
LDL-C (mg/dl)	107±32	109±31	106±29	113±32	111±32
HDL-C (mg/dl)	64±15	51±13	52±13	50±13	50±13*
HbA_{1c} (%)	5.9±1.2	6.1±1.2	5.9±1.1	6.2±1.3	6.1±1.1
AA/EPA	1.9±0.7	2.5±1.5	2.5±1.3	2.6±1.7	2.3±1.4
BNP (pg/dl)	28±35	206±680	170±376	264±605	252±452
CRP (mg/dl)	0.26±0.45	0.49±1.49	0.37±1.12	0.67±1.9	0.74±1.9
Angiographic findings (%)					
LAD	–	61	49	77	65
LCX	–	45	24	75	53
RCA	–	43	27	67	50
Medications (%)					
ACEI/ARB	47	64	71	58	50
CCB	47	44	47	40	50
Statin	37	46	50	42	44
β-blocker	16	23	20	27	19
Aspirin	42	58	63	52	69
Nitrate	21	10	13	6	31
Treatment (%)					
Medication only	–	27	33	23	20
PCI	–	63	63	63	23†
BMS	–	55	60	47	15†
DES	–	45	40	53	85†
CABG	–	10	4	14	57†

Data given as mean±SD or (%).
*P<0.05 vs. normal; †P<0.05 vs. all non-LMCAD. HbA_{1c} was determined according to the definition of Japan Diabetes Society.
LMCAD, left main coronary artery disease; eGFR, estimated glomerular filtration rate; CKD, chronic kidney disease; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; HbA_{1c}, hemoglobin A_{1c}; AA, arachidonic acid; EPA, eicosapentaenoic acid; BNP, brain natriuretic peptide; CRP, C-reactive protein; LAD, left anterior descending artery; LCX, left circumflex coronary artery; RCA, Right coronary artery; ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; CCB, calcium channel blocker; PCI, percutaneous coronary intervention; BMS, bare metal stent; DES, drug-eluting stent; CABG, coronary artery bypass grafting.

3 groups (single-vessel disease without LMCAD, n=314; multi-vessel disease without LMCAD, n=271; and LMCAD, n=95), eGFR clearly decreased as coronary artery disease became more severe, and patients with LMCAD had the lowest mean eGFR among the 3 groups. CKD was more prevalent among patients with LMCAD than among non-LMCAD patients (58% vs. 45%, P=0.02).

The risk factors associated with LMCAD were analyzed on multivariate logistic regression. As shown in **Table 2**, CKD was independently associated with LMCAD (adjusted odds ratio, 1.74, 95% confidence interval: 1.09–2.76, P=0.01).

Protocol 2

Clinical Outcomes Kaplan-Meier curves that illustrate the percentage of MACCE-free patients over time during the first year after treatment are shown in **Figure**. Data for all patients (**Figure A**) and for patients with LMCAD (**Figure B**) are shown. During this time interval, we were able to track 56 patients with LMCAD. Of these 56 individuals, 13 received PCI (23%), 32 had CABG (57%), and 11 were treated with medication only (20%) as initial therapies. With regard to the non-LMCAD patients, we were able to track 249 patients. Of these 249 individuals, 157 received PCI (63%), 24 had CABG

Table 2. Impact of CKD on Prevalence of LMCAD

	Univariate analysis			Multivariate analysis		
	OR	95%CI	P value	OR	95%CI	P value
CKD	1.67	1.07–2.60	0.02	1.74	1.09–2.76	0.01
Age	1.01	0.99–1.04	0.12			
Male gender	1.24	0.76–2.02	0.37			
Diabetes mellitus	0.87	0.51–1.48	0.61			
Hypertension	1.44	0.87–2.38	0.14			
Dyslipidemia	1.47	0.92–2.34	0.10	1.48	0.92–2.37	0.09
Smoking	0.79	0.51–1.24	0.31			

OR, odds ratio; CI, confidence interval. Other abbreviations as in Table 1.

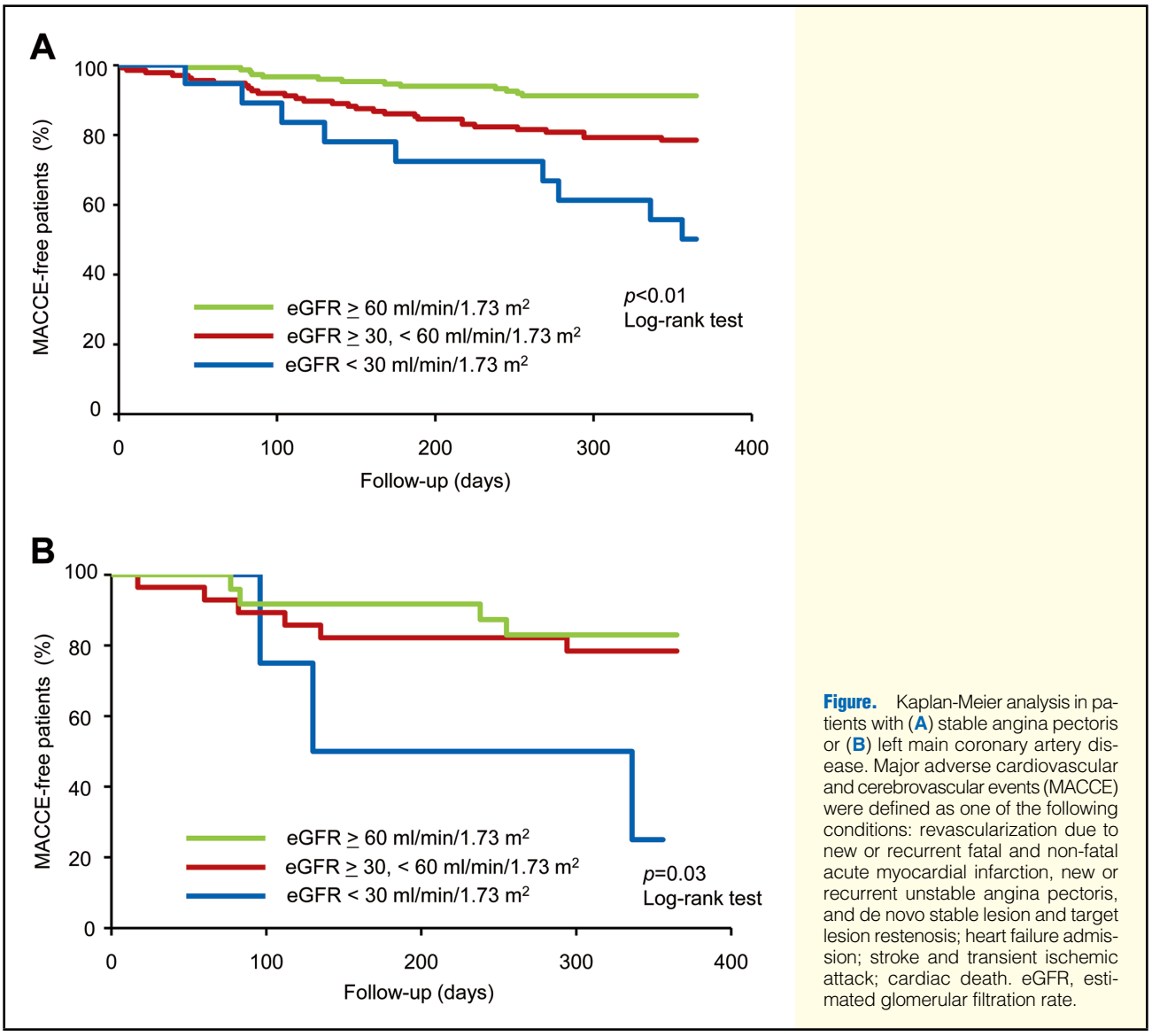

Figure. Kaplan-Meier analysis in patients with (**A**) stable angina pectoris or (**B**) left main coronary artery disease. Major adverse cardiovascular and cerebrovascular events (MACCE) were defined as one of the following conditions: revascularization due to new or recurrent fatal and non-fatal acute myocardial infarction, new or recurrent unstable angina pectoris, and de novo stable lesion and target lesion restenosis; heart failure admission; stroke and transient ischemic attack; cardiac death. eGFR, estimated glomerular filtration rate.

(10%), and 68 were treated with medication only (27%). Patients with eGFR <30 ml·min^{-1}·1.73 m^{-2} more frequently experienced MACCE. This held true for both patients with stable angina pectoris and patients with LMCAD.

Patients subsequently were reassigned to 6 groups on the basis of their LMCAD status and eGFR. The MACCE for those groups are listed in Table 3. Clinical characteristics such as age, gender, hypertension, diabetes mellitus, dyslipidemia, and medications did not differ between the groups, but treatments such as PCI and CABG did differ (Table S1). As shown in Table 4, multivariate logistic analysis indicated that the risk of MACCE in non-LMCAD patients with eGFR <30 ml·

Table 3. MACCE vs. Presence of LMCAD

	eGFR (ml·min^{-1}·1.73 m^{-2})			P value
	<30	≥30, <60	≥60	
Non-LMCAD				
n	15	111	123	
MACCE (total)	6	23	8	<0.01
Revascularization	2	10	8	NS
Hospitalization for HF	2	8	0	0.01
Cardiac death	1	3	0	NS
Cerebrovascular events	1	2	0	NS
LMCAD				
n	4	28	24	
MACCE (total)	3	6	5	0.05
Revascularization	2	2	2	0.03
Hospitalization for HF	1	4	2	NS
Cardiac death	0	0	1	NS
Cerebrovascular events	0	0	0	NS

MACCE, major adverse cardiovascular and cerebrovascular events; HF, heart failure. Other abbreviations as in Table 1.

Table 4. Effect of Renal Dysfunction on MACCE vs. Presence of LMCAD

eGFR (ml·min^{-1}·1.73 m^{-2})	No. patients	MACCE (%)	HR (95%CI)	P value
Non-LMCAD				
≥60	123	7	1.00	
≥30, <60	111	21	2.39 (1.35–4.26)	<0.01
<30	15	40	6.82 (3.21–14.52)	<0.01
LMCAD				
≥60	24	17	2.25 (0.86–5.88)	NS
≥30, <60	28	21	1.86 (0.70–4.93)	NS
<30	4	75	9.54 (3.15–28.89)	<0.01

This multivariate logistic analysis was adjusted for PCI and CABG.
HR, hazard ratio. Other abbreviations as in Tables 1–3.

min^{-1}·1.73 m^{-2} was approximately 7-fold higher than for non-LMCAD patients with eGFR ≥60 ml·min^{-1}·1.73 m^{-2}. Furthermore, the risk of MACCE in LMCAD patients with eGFR <30 ml·min^{-1}·1.73 m^{-2} was approximately 9-fold higher than for non-LMCAD patients with eGFR ≥60 ml·min^{-1}·1.73 m^{-2}. Thus, the risks of MACCE in both groups for patients with eGFR <30 ml·min^{-1}·1.73 m^{-2} were similarly high in spite of the presence or absence of LMCAD.

Discussion

In this study, we demonstrated that (1) CKD was independently associated with the presence of LMCAD in patients with stable angina pectoris, even though the frequency of traditional risk factors such as advanced age, male gender, hypertension, dyslipidemia, diabetes mellitus, and smoking did not differ between patients with and without LMCAD; and (2) the risk ratio of MACCE in patients with eGFR <30 ml·min^{-1}·1.73 m^{-2} was similar between patients with stable angina pectoris with and without LMCAD. These results suggest that CKD is an independent risk factor of LMCAD and that the impact of CKD adversely affects the outcomes of patients both with and without LMCAD treated with optimal initial treatment.

In this study, LMCAD occurred in 15% of patients with stable angina pectoris. Previous studies have reported LMCAD in approximately 3–8% of stable angina pectoris patients.[2,20,21] The high level of LMCAD in the present study may reflect the criteria for patient selection. The present subjects had significant stenosis (>50% coronary artery narrowing in at least 1 vessel, as determined on coronary angiography). As a consequence, subjects with stable angina pectoris and coronary narrowing <50% were excluded from the study. Among the 1,601 consecutive patients who underwent coronary angiography during the study period, the percentage of patients with LMCAD was 5.9%. Further, almost all of the present patients with LMCAD had significant stenosis in an additional major coronary artery. These findings support the hypothesis that LMCAD represents the most advanced stage of coronary atherosclerosis. These results also are consistent with earlier studies, which demonstrated that >90% of patients with LMCAD have significant disease in an additional coronary artery.[20,22–24]

The present results show for the first time that CKD is an independent factor associated with LMCAD. Efforts have been made in the past to identify clinical risk profiles that predict LMCAD, but those efforts have had limited success.[2,4,25] The LMCAD risk factor profile established to date is similar to that associated with diffuse and multi-vessel coronary artery disease. In agreement with previous studies, the present findings identified comparable clinical characteristics between patients with stable angina pectoris and multi-vessel disease and patients with LMCAD. The eGFR, however, was the only factor that differed between the non-LMCAD and LMCAD groups. Intriguingly, eGFR levels gradually decreased as the severity of coronary artery disease worsened. Specifically, patient

groups could be ranked on the basis of eGFR level (high to low): (1) control; (2) single-vessel disease without LMCAD; (3) multi-vessel disease without LMCAD; and (4) LMCAD. Many patients with LMCAD had the most advanced stage of coronary atherosclerosis, and the severity of renal insufficiency has been shown to correlate closely with the severity of coronary artery disease.[26] In the present study, the prevalence of dyslipidemia in the LMCAD group was shown to be higher than that in the control group and the non-LMCAD group, but logistic analysis failed to confirm dyslipidemia as an independent risk factor for LMCAD. One possible reason is that the statistical power was not sufficient due to the relatively small number of subjects. We also evaluated the relationship between LMCAD and AA/EPA ratio, which is a promising risk factor for cardiovascular events.[27] We found that the AA/EPA ratio did not correlate with the prevalence of LMCAD or with the severity of coronary artery disease. In addition, the risk factors for CKD such as advanced age, hypertension, dyslipidemia, diabetes mellitus, and smoking are, however, also risk factors of severe coronary artery disease. Therefore, it is possible that the association between CKD and the prevalence of LMCAD was simply due to residual confounding factors. In this study, CKD was found to be an increased risk for the presence of LMCAD, while the number of patients enrolled in this study was limited. A larger study is needed to clarify other potential risk factors of LMCAD.

The mechanisms that underlie the association between renal dysfunction and coronary artery disease have not been elucidated fully. Previous studies have shown that renal dysfunction is associated with low-grade inflammation and activation of the sympathetic nervous system or the rennin-angiotensin-aldosterone system.[28–30] Other factors such as calcium-phosphate production, oxidative stress, and abnormal apolipoprotein levels also were shown to promote renal dysfunction.[31,32] As such, these factors could also contribute to the pathogenesis of atherosclerosis. To evaluate the relationship between oxidative stress and LMCAD, we measured plasma levels of malondialdehyde-modified low-density lipoprotein (MDA-LDL) in approximately half of the subjects enrolled in this study (data not shown). No association was found, however, between the presence of LMCAD and MDA-LDL levels. Further investigation is needed to identify the specific factors that link CKD and LMCAD.

The present study evaluated the impact of renal dysfunction on MACCE in patients with or without LMCAD, who were treated with only medication or PCI or CABG. In patients with severe renal dysfunction, the risk of MACCE was 7–9-fold higher than for patients with mild renal dysfunction (regardless of their LMCAD status). In contrast, as shown in **Table 3**, patients with eGFR $<30\,ml \cdot min^{-1} \cdot 1.73\,m^{-2}$ and LMCAD had a 2-fold greater chance of suffering MACCE than patients with eGFR $<30\,ml \cdot min^{-1} \cdot 1.73\,m^{-2}$ and non-LMCAD. These results imply that the influence of renal dysfunction on cardiovascular events after revascularization is greater than the influence of LMCAD. Recent improvements in PCI or CABG have provided a safer and more feasible treatment for LMCAD.[13] Even if PCI and CABG effectively resolve the stenosis associated with left main coronary artery, the incidence of new lesions and other complications remains high in patients with severe renal dysfunction. Medications do not adequately protect against the development of new coronary lesions in patients with severe renal dysfunction. This may explain the comparable impact of renal dysfunction on MACCE regardless of LMCAD, but the follow-up in the present study was limited to 1 year. Longer follow-up is required to evaluate cardiovascular death. There are many theories to explain the association between renal dysfunction and increased risk of MACCE. For example, patients with chronic renal failure may not have symptoms typically associated with restenosis, which could result in severe silent ischemia. Suboptimal medical therapies (eg, under-use of beta-blockers, angiotensin-converting enzyme inhibitors, and statins) also worsen health outcomes for these patients. We also found that the proportion of patients under statins was smaller in the LMCAD group than in the non-LMCAD group. In addition, recent studies showed that lower eGFR is associated with lipid-rich composition in coronary plaque, using integrated backscatter intravascular ultrasound,[33] and with PCI-related myocardial injury. Thus, plaque vulnerability associated with lower eGFR explains the relationship between renal dysfunction and increased risk of MACCE.

Study Limitations

First, only approximately half of the enrolled patients were followed up. In addition, the follow-up period was short. Therefore, we cannot deny that those lost subjects and the short-follow up period may have affected the impact of renal function on outcomes and the comparison of outcomes between patients with and without LMCAD. Second, some patients with CKD were categorized on the basis of a single eGFR measurement. This eGFR value was derived from a single serum creatinine determination done on the day of the coronary angiogram. This creatinine value may have been influenced by medication or an acute clinical status. Third, we did not have data concerning the course of renal function in these patients, either before or after the angiogram. There is a common tendency to refrain from coronary angiography, which can decrease the eGFR. As such, we could not address the influence of these factors on outcomes. Fourth, we included a few patients with end-stage renal disease who required dialysis. The data for these patients may have affected the relationships between risk factors and health outcomes. Fifth, patients underwent PCI or medication only, instead of CABG, because of either the patient's or physician's preference or the high risk associated with CABG. We cannot deny the possibility that the selection of treatment could have affected the results.

Conclusions

CKD is independently associated with LMCAD in patients with stable angina pectoris. Furthermore, severe renal dysfunction significantly affected the incidence of MACCE after optimal initial treatment of patients with and without LMCAD. Therefore, meticulous attention is required with regard to renal dysfunction when treating patients with stable angina pectoris.

Acknowledgment

There is no conflict of interest.

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Supplementary Files

Supplementary File 1

Table S1. Patient Characteristics vs. Presence of LMCAD and Renal Function

Please find supplementary file(s);
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