In-Hospital Clinical Outcomes of Elderly Patients (≥80 Years) Undergoing Percutaneous Coronary Intervention

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Background: The clinical outcomes of elderly patients (≥80 years old) undergoing percutaneous coronary intervention (PCI) has not been well established, despite recent advances in both devices and techniques.

Methods and Results: We recruited patients from the SHINANO Registry, a prospective, observational, multicenter, cohort study. From August 2012 to July 2013, a total of 1,923 consecutive patients with 2,250 elective/urgent PCIs (2,105 admissions) (mean age, 71±11 years; ≥80 years, 23%; men, 77%) were enrolled. The primary endpoint was procedural success. The secondary endpoints were in-hospital death and in-hospital major adverse cardiovascular events (MACE). The procedural success rate was significantly lower (83.7% vs. 89.1%, $P=0.0001$), and the rates of in-hospital mortality and MACE were significantly higher in elderly than in non-elderly patients (3.6% vs. 1.5%, $P=0.005$; 4.4% vs. 2.3%, $P=0.016$, respectively). For elective PCI, the rates of procedural success and in-hospital MACE were similar between groups (90.3% vs. 91.3%, $P=0.65$; 2.3% vs. 1.2%, $P=0.2$, respectively). On multivariate analysis, being elderly was not an independent predictor of procedural failure (OR, 1.15; CI, 0.81–1.61; $P=0.43$).

Conclusions: In elderly patients, PCI is safe and feasible. The presence of comorbidities is a more important factor than age alone. (*Circ J* 2014; **78**: 1097–1103)

Key Words: Coronary artery disease; Elderly; Percutaneous coronary intervention

Worldwide, the general population is aging, and octogenarians are the fastest growing population.¹ Japan is one of the countries with an old population. The Cabinet Office of the Government of Japan reported that Japanese life expectancy would increase from 79.4 years in men and 85.9 years in women in 2011 to 84.2 years in men and 90.9 years in women in 2060.² Older age is an indepen-

dent predictor for arteriosclerosis and cardiovascular events.³ Elderly patients tend to have extensive comorbidities and complex coronary lesions, which can make both the patient and clinician hesitant about percutaneous coronary interventions (PCI), even though the TIME study suggested that in elderly patients, revascularization treatment is safe and more effective than the optimal medical treatment for symptoms.⁴ New devices

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and techniques for PCI have been developed in recent years, including a debulking device, drug-eluting stents (DES), a transradial approach, and sheathless guiding catheter for less invasive PCI. However, the clinical outcomes of elderly patients undergoing PCI has not yet been well established. It is important to update Japanese real-world data for the management of elderly patients undergoing PCI in the contemporary era.

Nagano Prefecture in Japan has the highest life expectancy among all prefectures. The Shinshu Prospective Multi-center Analysis for Elderly Patients with Coronary Artery Disease Undergoing Percutaneous Coronary Intervention (SHINANO) Registry was initiated to evaluate the clinical outcome, treatment, and clinical and lesion characteristics in elderly patients undergoing PCI.

This study presents the differences in baseline characteristics and short-term outcomes after initial PCI between elderly and non-elderly patients in the SHINANO Registry. We evaluated in-hospital clinical outcomes of elderly patients undergoing PCI.

Methods

Study Design

The SHINANO Registry is a prospective, multicenter, observational registry designed to provide up to 12 months of clinical follow-up. Between August 2012 and July 2013, a total of 1,923 consecutive patients with 2,250 PCIs (2,105 admissions) for any coronary artery disease (stable angina, ST-segment elevation myocardial infarction [STEMI], non-STEMI [NSTEMI], and unstable angina [UA]) were enrolled from 16 institutions in Nagano prefecture. This study had no exclusion criteria and was an all-comer registry.

Patients were enrolled after approval of each hospital's ethics committee and after informed consent was given by the patients. This study was performed in accordance with the Declaration of Helsinki. The SHINANO Registry is registered with the University Hospital Medical Information Network-Clinical Trials Registry (UMIN-CTR), as accepted by the International Committee of Medical Journal Editors (No. UMIN 000010070).

Endpoints

The primary endpoint was procedural success. The secondary endpoints were in-hospital death and in-hospital major adverse cardiovascular events (MACE; all-cause death, myocardial infarction [MI], stroke, and stent thrombosis).

Study Procedure

All patients were pretreated with ticlopidine (200 mg daily) or clopidogrel (75 mg daily), in addition to aspirin (100–200 mg daily). A loading dose of 300 mg of clopidogrel was administered to clopidogrel-naïve patients. Aspirin and thienopyridines were started at least 2 days before elective stenting. The interventional strategy and stent selection were left to the discretion of the operator in all procedures.

Definitions

Elderly age was defined as ≥ 80 years old. Acute coronary syndrome (ACS) is a composite of STEMI, NSTEMI and UA. STEMI was diagnosed in patients with chest symptoms, ST-segment elevation ≥ 1 mV in 2 or more limb leads or ≥ 2 contiguous precordial leads or left bundle branch block, and elevated biochemical markers of myocardial necrosis (troponin T levels ≥ 0.1 ng/ml or creatine phosphokinase 2-fold above the normal range). NSTEMI was diagnosed in patients with chest symptoms, ST-segment depression ≤ 0.05 mV, T-wave inver-

sion ≥ 0.3 mV, or transient <0.05 mV ST-segment elevation, and elevated biochemical markers of myocardial necrosis (and no ECG abnormalities for STEMI). UA was diagnosed in patients with persistent resting or nocturnal chest pain together with additional findings. Angiographic success was defined as achievement of a minimum stenosis diameter reduction to less than 20% with grade 3 Thrombolysis In Myocardial Infarction (TIMI) flow. Procedural success was defined as achievement of angiographic success without any complications during hospitalization. Procedural failure was defined as the inability to complete PCI or any complications during hospitalization. Complications were defined as all-cause mortality, procedure-related stroke, procedure-related MI, bleeding complications, cholesterol crystal embolization (CCE), worsened renal function, coronary artery perforation or rupture, coronary dissection, stent thrombosis, final TIMI flow ≤ 2 from any coronary event, or any other event requiring prolonged hospitalization. Bleeding complications were defined as blood transfusion or prolonged hospitalization owing to hematoma, gastrointestinal bleeding, or intracranial bleeding. Procedure-related MI was defined as creatine kinase (CK) or CK-MB above the upper limit of normal at each hospital or as the development of significant Q waves in at least 2 contiguous leads of the ECG. Coronary artery disease (CAD) was defined as $>50\%$ stenosis in a coronary vessel on angiography, history of coronary artery bypass graft surgery or PCI, or previous MI. Stroke was defined as ischemic stroke that persisted for ≥ 24 h and was diagnosed by a neurologist. Heart failure (HF) was based on a previous diagnosis of HF, history of hospitalization for HF, or current treatment for HF. Diabetes was defined as HbA1c $\geq 6.5\%$, casual plasma glucose ≥ 200 mg/dl or treatment with oral hypoglycemic agents or insulin injection. Hypertension was defined as systolic blood pressure (BP) ≥ 140 mmHg, diastolic BP ≥ 90 mmHg, or ongoing therapy for hypertension. Dyslipidemia was defined as a serum total cholesterol concentration ≥ 220 mg/dl, a low-density lipoprotein-cholesterol concentration ≥ 140 mg/dl, or current treatment with lipid-lowering therapy. Body mass index was defined as weight in kilograms divided by the square of height in meters. Chronic kidney disease was defined as creatinine clearance <30 ml/min estimated using the Cockcroft-Gould formula. Left ventricular ejection fraction (LVEF) was measured by echocardiography and LVEF $\leq 40\%$ indicated LV dysfunction. Multivessel disease was defined as the presence of a $\geq 75\%$ lesion in ≥ 2 major coronary arteries. Documented peripheral artery disease (PAD) consisted of 1 or both criteria: current intermittent claudication with an ankle-brachial index ≤ 0.9 or a history of intermittent claudication with a previous and related intervention, such as peripheral arterial bypass graft, stenting, angioplasty, atherectomy, or other vascular interventions, including amputation.

Statistical Analysis

Continuous variables are reported as mean $\pm$ standard deviation. Categorical variables are reported as frequencies and percentages. Patient characteristics of the 2 age groups were compared using chi-squared tests. Continuous variables were compared by t-test. For each age group, multivariate logistic proportional hazard models were used to adjust for the effects of baseline risk factors on initial PCI success. $P < 0.05$ was considered statistically significant in all analyses.

Results

Baseline Demographics

Patient characteristics are shown in [Table 1](#). Of the 1,923 patients, 441 (22.9%) were elderly (≥ 80 years old, 37 patients ≥ 90

Table 1. Clinical Characteristics

	Overall	Age ≥80 years	Age <80 years	P value
n	1,923	441	1,482	
Mean age (years)	70.7±11.0	84.1±3.4	66.6±9.1	<0.0001
Male (%)	1,471 (76.5)	257 (58.3)	1,214 (81.9)	<0.0001
BMI	23.8±3.6	22.3±3.3	24.2±3.6	<0.0001
Hypertension (%)	1,388 (72.2)	348 (78.9)	1,040 (70.2)	<0.0001
Dyslipidemia (%)	1,147 (59.7)	209 (47.4)	938 (63.3)	<0.0001
Diabetes (%)	704 (36.6)	132 (30.0)	572 (38.6)	0.001
Oral (%)	441 (22.9)	86 (19.5)	355 (24.0)	0.059
Insulin (%)	142 (7.4)	24 (5.4)	118 (8.0)	0.081
Hb	13.9±5.9	12.9±4.0	14.4±6.8	<0.0001
eGFR	61.5±24.4	53.9±21.7	63.5±23.8	<0.0001
Hemodialysis (%)	112 (5.8)	17 (3.9)	95 (6.4)	0.047
Current smoker (%)	354 (18.4)	30 (6.8)	324 (21.9)	<0.0001
Previous smoker (%)	974 (50.7)	158 (35.8)	816 (55.1)	<0.0001
Previous MI (%)	485 (25.2)	114 (25.9)	371 (25.0)	0.69
Previous CABG (%)	146 (7.6)	30 (6.8)	116 (7.8)	0.49
Previous stroke (%)	183 (9.5)	64 (14.5)	119 (8.0)	<0.0001
Previous intracranial bleeding (%)	28 (1.5)	13 (3.0)	15 (1.0)	0.003
PAD (%)	197 (10.2)	65 (14.7)	132 (8.9)	<0.0001
Heart failure (%)	256 (13.3)	91 (20.6)	165 (11.1)	<0.0001
AF (%)	208 (10.8)	76 (17.2)	132 (8.9)	<0.0001
LVEF (%)	60.1±13.4	58.8±13.8	60.4±13.3	0.041
LV dysfunction ^a (%)	171 (8.9)	48 (10.9)	123 (8.3)	0.073
Medication at discharge				
n	2,063	460	1,603	
Aspirin (%)	1,962 (95.1)	431 (93.7)	1,531 (95.5)	0.88
Thienopyridines (%)	1,823 (88.4)	399 (86.7)	1,424 (88.8)	0.73
EPA (%)	79 (3.8)	10 (2.1)	69 (4.3)	0.04
Statins (%)	1,464 (71.0)	284 (61.7)	1,180 (73.6)	<0.0001
ACEI/ARB (%)	1,350 (65.4)	287 (62.4)	1,063 (66.3)	0.23
β-blocker (%)	841 (40.8)	164 (35.7)	677 (42.2)	0.017
Warfarin (%)	219 (10.6)	54 (11.7)	165 (10.3)	0.32
NOAC (%)	32 (1.6)	5 (1.1)	27 (1.7)	0.38

^aLV dysfunction was defined as ≤40% of LVEF.

ACEI, angiotensin-converting enzyme inhibitor; AF, atrial fibrillation; ARB, angiotensin receptor blocker; BMI, body mass index; CABG, coronary artery bypass grafting; EPA, eicosapentaenoic acid; LVEF, left ventricular ejection fraction; MI, myocardial infarction; NOAC, new oral anticoagulant drug; PAD, peripheral arterial disease.

years old) and 1,482 (77.1%) were non-elderly. Mean age was 84.1±3.4 years in the elderly group and 66.6±9.1 years in the non-elderly group. The elderly group had a significantly lower percentage of men (58.3% vs. 81.9%, $P<0.0001$). In terms of comorbidities, dyslipidemia, diabetes, hemodialysis, current smoking, and previous smoking were observed more frequently in the non-elderly patients. On the other hand, the elderly patients had higher rates of hypertension, previous stroke, previous cranial bleeding, PAD, previous HF, and arterial fibrillation than the non-elderly patients. LVEF was not significantly different between the elderly and non-elderly groups (59.1±13.4% vs. 60.5±13.4%, $P=0.091$). The elderly patients presented with ACS more frequently than the non-elderly patients (44.2% vs. 39.6%, $P=0.046$).

Angiographic Findings

The characteristics of the lesions and procedures are shown in **Table 2**. Similar lesional characteristics, including multivessel disease, left main trunk disease, bifurcation lesions, and chronic total occlusions, were found in both groups. However, the

percentage of calcified lesions and ostial lesions was significantly higher in the elderly group. As a result, the SYNTAX score was significantly higher in the elderly group than in the non-elderly group (13.5±9.0 vs. 12.5±8.7, $P=0.032$).

In-Hospital Complications

There were 220 complications during hospitalizations; 157 cases of complications during the PCI procedure (6.9%), including coronary perforation in 23 patients (1.0%), PCI-related stroke in 2 patients (0.08%), and final TIMI flow ≤2 caused by distal embolization in 139 patients (6.2%). The rate of total complications during PCI was not significantly different between the elderly and non-elderly patients (8.1% vs. 6.6%, $P=0.24$). In terms of each complication during PCI, the incidences of coronary perforation, PCI-related stroke, and final TIMI flow ≤2 were similar between groups (1.0% vs. 1.0%, $P=0.89$, 0% vs. 0.1%, $P=0.44$, 7.6% vs. 5.8%, $P=0.14$, respectively). Furthermore, the angiographic success rate was not significantly different between groups (90.7% vs. 92.9%, $P=0.098$), despite the difference in lesion complexity between the elderly and non-

Table 2. Lesional Characteristics

	Overall	Age ≥80 years	Age <80 years	P value
n	2,250	516	1,734	
ACS	914 (40.6)	228 (44.2)	686 (39.6)	0.046
Multivessel disease (%)	928 (41.2)	220 (42.6)	709 (40.9)	0.479
De novo	1,971 (87.6)	454 (88.5)	1,517 (87.6)	0.579
DES ISR	108 (4.8)	21 (4.1)	87 (5.0)	0.377
BMS ISR	165 (7.3)	41 (8.0)	124 (7.2)	0.549
LMT lesions	63 (2.8)	17 (3.3)	46 (2.7)	0.438
Calcified lesions	658 (29.3)	180 (35.2)	478 (27.8)	0.001
Ostial lesions	174 (7.7)	55 (10.7)	119 (6.9)	0.005
Bifurcation lesions	602 (26.8)	131 (25.5)	471 (27.4)	0.396
CTO lesions	174 (7.7)	39 (7.6)	135 (7.8)	0.865
SYNTAX score	12.7±8.8	13.5±9.0	12.5±8.7	0.032
PCI procedure				
TFI (%)	680 (30.2)	162 (31.4)	518 (29.9)	0.35
TBI (%)	87 (3.9)	19 (3.7)	68 (3.9)	0.29
TRI (%)	1,423 (63.2)	324 (62.8)	1,099 (63.4)	0.29
BMS use (%)	796 (35.4)	194 (37.6)	602 (34.7)	0.23
DES use (%)	1,086 (48.3)	244 (47.3)	842 (48.6)	0.612

ACS, acute coronary syndrome; BMS, bare metal stent; CTO, chronic total occlusion; DES, drug-eluting stent; ISR, in-stent restenosis; LMT, left main trunk; TBI, transbrachial intervention; TFI, transfemoral intervention, TRI, transradial intervention.

Figure 1. Rates of procedural and angiographic success overall.

elderly patients.

In-Hospital Procedural Success

The angiographic success rate and the rate of complications during PCI were not significantly different between the elderly and non-elderly groups. However, the total complications during hospitalization were significantly higher in the elderly group than in the non-elderly group (15.1% vs. 9.8%, $P=0.001$). Therefore, the procedural success rate was significantly lower in the elderly group than in the non-elderly group (**Figure 1**). In patients with ACS, the procedural and angiographic success rates were significantly lower in the elderly group than in the non-elderly group (75.8% vs. 85.8%, $P=0.001$, 85.1% vs. 90.4%, $P=0.008$) (**Figure 2A**).

Among the patients with non-ACS, the procedural and angiographic success rates were not significantly different between the elderly and non-elderly groups (90.3% vs. 91.3%,

$P=0.61$, 95.1% vs. 94.6%, $P=0.70$) (**Figure 2B**).

Regarding in-hospital deaths, there were 42 cases during hospitalization, including cardiac death in 31 patients (1.5%; 29 presented with ACS, 2 presented with non-ACS), and, non-cardiac death in 11 patients (0.5%). Non-cardiac deaths included gastrointestinal bleeding (3 patients, 0.14%), intracranial bleeding (2 patients, 0.1%), sepsis (2 patients, 0.1%), ischemic colitis (1 patients, 0.05%), hematologic malignancy (1 patients, 0.05%), and pneumonia (2 patients, 0.1%). The in-hospital mortality rate was significantly higher in the elderly group than in the non-elderly group (**Figure 3**). Regarding the in-hospital MACE, the incidence of PCI-related MI, PCI-related stroke, and stent thrombosis was not significantly different between the 2 groups (0.4% vs. 0.4%, $P=0.87$, 0.4% vs. 0.4%, $P=0.87$, 0.6% vs. 0.2%, $P=0.11$, respectively). However, the rate of in-hospital MACE was significantly higher in the elderly group than in the non-elderly group (**Figure 3**). Furthermore, the duration

of hospitalization was significantly longer in the elderly group than in the non-elderly group (15.9 ± 23.7 days vs. 10.7 ± 16.0 days, $P < 0.0001$).

Predictors of Procedural Failure and MACE

Logistic regression analysis was performed to evaluate the power of age and other variables on procedural failure (Table 3) and MACE (Table 4). On multivariate analysis, older age was not an independent predictor of procedural failure and MACE. The presence of LV dysfunction, previous intracranial bleeding, and atrial fibrillation, ACS at admission, and estimated glomerular filtration rate were independent predictors of procedural failure and MACE. The SYNTAX score was an independent predictor of procedural failure, but had only a tendency to be an independent predictor of MACE.

Discussion

The SHINANO Registry is a large-scale, prospective, multi-center, observational registry of all CAD patients who have undergone PCI at regional cardiac centers, not including high-volume PCI centers. Each institution had 100–500 PCI cases/

year. Therefore, this registry revealed early outcomes of contemporary application of PCI in elderly patients treated in Japanese standard city hospitals. Approximately 25% of the patients were ≥ 80 years old in our study. There were more women at an advanced age, as in previous reports.⁵

Baseline Characteristics and Angiographic Findings

The elderly patients had more severe coronary lesions and more extensive comorbidities than the non-elderly patients in this study. The prevalence of diabetes, smoking, and hyperlipidemia was significantly lower in the elderly group than in the non-elderly group, which is consistent with previous studies of elderly patients.^{6–8} This result suggests that patients with severe diabetes, hyperlipidemia, and who smoke tend to die earlier from their comorbidities.

In-Hospital Adverse Outcomes and Complications

The angiographic success rate was similar in both groups; however, the elderly group had a lower procedural success rate, a longer duration of hospitalization, and a higher rate of in-hospital mortality and ischemic events than the non-elderly group.

Previous reports show that elderly patients who undergo PCI

Table 3. Univariate and Multivariate Predictors of Procedural Failure

Variable	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Elderly	1.59 (1.19–2.13)	0.002	1.15 (0.81–1.61)	0.43
Female	1.48 (1.11–1.97)	0.008	1.28 (0.91–1.79)	0.15
BMI <18	1.50 (0.81–2.75)	0.20		
eGFR	0.99 (0.98–0.99)	<0.0001	0.99 (0.98–0.99)	0.005
Multivessel disease	1.35 (1.504–1.75)	0.026		
LV dysfunction ^a	2.63 (1.82–3.79)	<0.0001	1.78 (1.16–2.74)	0.009
Previous heart failure	1.64 (1.17–2.30)	0.004		
ACS	2.07 (1.59–2.70)	<0.0001	1.99 (1.48–2.70)	<0.0001
Previous intracranial bleeding	3.95 (1.81–8.58)	0.001	3.62 (1.53–8.53)	0.003
AF	1.85 (1.28–2.66)	0.001	1.87 (1.25–2.80)	0.003
SYNTAX Score	1.05 (1.04–1.07)	<0.0001	1.04 (1.03–1.04)	<0.0001
Calcified lesions	1.52 (1.16–2.00)	0.003		
Ostial lesions	1.70 (1.11–2.61)	0.014		
LMT lesions	2.61 (1.43–4.78)	0.002		

Elderly was defined as ≥80 years old. ^aLV dysfunction was defined as ≥40% of LVEF.

CI, confidence interval; eGFR, estimated glomerular filtration rate; OR, odds ratio. Other abbreviations as in Tables 1,2.

Table 4. Univariate and Multivariate Predictors of In-Hospital Major Adverse Cardiac Events

Variable	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Elderly	1.93 (1.12–3.32)	0.018	1.09 (0.56–2.13)	0.80
eGFR	0.98 (0.97–0.99)	0.001	0.99 (0.97–0.99)	0.03
Multivessel disease	1.80 (1.07–3.03)	0.027		
LV dysfunction ^a	6.42 (3.61–11.40)	<0.0001	5.33 (2.75–10.35)	<0.0001
Previous heart failure	2.84 (1.61–5.02)	<0.0001		
Previous intracranial bleeding	5.87 (1.98–17.44)	0.001	7.22 (2.18–23.89)	0.001
AF	2.24 (1.17–4.29)	0.015		
ACS	3.48 (1.96–6.16)	<0.0001	2.96 (1.50–5.81)	0.002
TIMI ≤2	5.27 (2.89–9.60)	<0.0001		
SYNTAX score	1.047 (1.022–1.072)	<0.0001	1.027 (0.99–1.06)	0.059
Ostial lesions	2.34 (1.23–4.85)	0.023		
LMT lesions	5.27 (2.28–12.16)	<0.0001		

Elderly was defined as ≥80 years old. ^aLV dysfunction was defined as ≥40% of LVEF.

TIMI, Thrombolysis In Myocardial Infarction. Other abbreviations as in Tables 1,2,3.

have a higher rate of in-hospital mortality, ischemic events, and complications and longer hospitalization than non-elderly patients.^{6–10} Appleby et al¹¹ reported that in-hospital mortality was significantly higher in very elderly patients (≥85 years old) than in patients <85 years old (6.93% vs. 1.20%, $P < 0.0001$). Renal, neurological, and bleeding complications were all greater in the very elderly cohort. In the current study, in-hospital mortality was significantly higher in the elderly patients than in the non-elderly patients who underwent PCI. Furthermore, very elderly patients (≥85 years old) had higher mortality (5% vs. 1.7%, $P = 0.003$). However, renal, neurological, and bleeding complications were similar between the elderly and non-elderly groups in the present study. Similar results were observed for very elderly patients and not-very elderly patients (<85 years old) (2.3% vs. 1.3%, $P = 0.21$; 0% vs. 0.1%; $P = 0.66$, 2.3% vs. 1.6%; $P = 0.72$). When comparing our results with those of other studies, our results for in-hospital adverse outcomes and PCI-related complications in the elderly and very elderly patients appear to be acceptable.

Predictors of Procedural Failure and MACE

Our study revealed that older age is not a strong predictor of procedural failure and in-hospital ischemic events, despite the 2-fold increase in both the procedural failure rate and the MACE rate in the elderly group compared with the non-elderly group. The elderly patients had more extensive comorbidities (renal insufficiency, PAD, previous HF, atrial fibrillation, and previous stroke and intracranial bleeding) and clinical presentation (ACS). These factors were stronger predictors of procedural failure and in-hospital ischemic events than age, which is consistent with previous studies of elderly patients.^{7,12,13} In particular, the rates of procedural failure and MACE in the patients with non-ACS were acceptable in both groups. Thus, the decision to perform PCI in elderly patients should not be based on age alone. The presence of comorbidities should also be considered.

PCI Strategy in Elderly Patients

DES are more suitable than bare metal stents (BMS) for the treatment of elderly patients with more complex coronary disease.

In the current study, the SYNTAX score was significantly higher in the elderly patients than in the non-elderly patients. The Xima trial revealed that the incidence of MI and target vessel revascularization was lower (without an increased incidence of major hemorrhage) with the use of second-generation DES than with BMS.¹⁴ In that trial, the patients with DES were prescribed dual antiplatelet therapy (DAPT) for 1 year. Recently, it was shown that in patients with stable CAD or low-risk ACS treated with second-generation DES, 3 months of DAPT was noninferior to 12 months of DAPT for MACE or major bleeding, without significantly increasing the risk of stent thrombosis.¹⁵ Therefore, the length of DAPT for DES has become shorter worldwide. Accordingly, elderly patients with CAD may be treated with DES, if they can be treated with short-term DAPT. In the current study, the in-hospital bleeding complication rate was similar between the elderly and non-elderly patients. That result suggests that short-term DAPT in elderly patients with DES is safe, in terms of bleeding complications. In the current study, the percentage of DES was similar between the elderly and non-elderly patients, and was also similar between the 2 groups of elective PCI (60.4% vs. 59.6%, $P=0.81$) and urgent PCI (30.7% vs. 31.6%, $P=0.79$).

Prior reports have consistently documented that the transradial approach in primary PCI has the strong, important benefit of reducing vascular complications as compared with the transfemoral approach in STEMI patients.¹⁶ In contrast, elderly patients tend to have more severe arteriosclerosis. Our study found that the prevalence of PAD and the rate of previous stroke were significantly higher in the elderly group than in the non-elderly group. Therefore, elderly patients with CAD may be treated by the transradial approach if their lesion can be treated without the strong backup support of a guiding system, a larger guiding system, or a double-access system. However, in the current study, the percentages of transfemoral approach and transradial approach were similar between the elderly and non-elderly patients. PCI in elderly patients tends to be difficult because of severe complex lesions (calcifications and ostial lesions, in particular). Therefore, there was no difference in the transfemoral approach rate in the 2 groups, despite the higher prevalence of comorbidities in the elderly group. In the near future, the development of less invasive PCI techniques that can be performed by the majority of cardiologists will result in improved PCI outcomes.

Study Limitations

Although this was a prospective, observational, multicenter cohort study, participating hospitals were not population-based, were not randomly selected, and were in Nagano Prefecture alone. Consecutive patients were enrolled in the current study; however, the decision to perform PCI was left to the discretion of the operator in all procedures, so selection bias could have occurred. Although the Euro Score is commonly used to predict short-term outcomes of cardiac surgery, there was insufficient data to calculate the Euro Score.

Conclusions

Although the in-hospital analysis of the SHINANO Registry revealed that the rates of procedural failure and in-hospital MACE were significantly higher in elderly patients than in non-elderly patients, the results were still feasible, particularly in patients who underwent elective PCI. Furthermore, our study revealed that elderly age was not a strong predictor of proce-

dural failure and in-hospital ischemic events. Therefore, PCI should be performed in elderly patients without hesitation. In the decision to perform PCI, the presence of baseline comorbidities is a more important factor to consider than age alone.

Disclosures

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