

## RESEARCH ARTICLE

# Risk Factors Associated with Acute Coronary Syndrome after Successful Percutaneous Coronary Intervention

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**Objective:** Admission for acute coronary syndrome after successful percutaneous coronary intervention is a delicate situation for the patient and doctor. Predictors of these cases are poorly described. **Methods:** We retrospectively analysed the files of post-percutaneous coronary intervention patients admitted to the Department of Cardiology of the Institute for Cardiovascular Disease and Heart Transplant in Tîrgu Mures between January 2012 and December 2015. Analyses using the t-test, chi-square test, and Fisher test were performed to compare demographics, clinical and angiographic characteristics of patients with acute coronary syndrome, patients with stable angina, and those without symptoms. **Results:** One hundred eighty post-percutaneous coronary intervention patients were readmitted; 46 patients (25.55%) were readmitted for acute coronary syndrome. Histories of arterial hypertension and renal dysfunction at hospital admission were associated with acute coronary syndrome. Bare metal stent in-stent restenosis and localisation of bare metal stent in-stent restenosis of the left descendent coronary artery were angiographic predictors of acute coronary syndrome. **Conclusion:** Several clinical and angiographic factors identify patients at high risk for acute coronary syndrome after successful percutaneous coronary intervention. Recognition and treatment of these factors may prevent readmission for such a dangerous condition and may improve outcomes.

**Keywords:** acute coronary syndrome, percutaneous coronary intervention, in-stent restenosis

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## Introduction

Coronary artery stents, both bare metal stents and drug-eluting stents, significantly reduce the incidence of events related to culprit lesion treated during the first (index) percutaneous coronary intervention; however, coronary artery disease is a continuous process. Reoccurrence of symptomatology, particularly acute coronary syndrome, is a challenging situation because acute coronary syndrome is still a major cause of death and has a high economic burden. Identification of factors that could predict the development of acute coronary syndrome, especially preventable factors, would be extremely useful for the clinical management of these patients.

## Methods

This was a single-centre retrospective analysis of 180 readmitted post-percutaneous coronary intervention patients over a 4-year period (January 2012-December 2015). Patients were divided into three groups: acute coronary syndrome patients, patients with stable angina, and asymptomatic patients. Baseline characteristics, cardiac history, risk factors, comorbidities, results of coronarography at the index percutaneous coronary intervention and at readmis-

sion, stent type used at the index percutaneous coronary intervention, and medication after percutaneous coronary intervention were compared between the three subgroups.

## Statistical analysis

Continuous variables were expressed as mean  $\pm$  standard deviation and compared using t-tests. Categorical variables were presented as numbers and percentages and compared using chi-square or Fisher tests. A p-value  $<0.05$  was considered statistically significant. All statistical analyses were performed using STATA 14.0 (Stata Corporation, College Station, TX, USA).

## Results

Forty-six (25.55%) patients with acute coronary syndrome, 101 (56.11%) patients with stable angina, and 33 (18.33) asymptomatic patients were readmitted after successful percutaneous coronary intervention (Table I).

Patients with acute coronary syndrome were older than asymptomatic patients ( $63.93 \pm 10.69$  vs.  $58.87 \pm 9.25$  years;  $p=0.031$ ) and more often had a history of myocardial infarcts than patients with stable angina ( $p=0.005$ ).

Arterial chronic hypertension and impaired renal function (estimated glomerular filtration rate  $\leq 60$  ml/min) were more frequent in the acute coronary syndrome group than in the other two groups. There were no other differences

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Table I. Baseline characteristics, cardiovascular risk factors, and comorbidities

	Stable angina group		Asymptomatic group		ACS group
	101 (56.11%)	*p	33 (18.33%)	*p	
Age, years	61.97 ± 9.72	0.273	58.87 ± 9.25	0.031	63.93 ± 10.69
Male, n (%)	76 (75.25)	0.652	27 (81.82)	0.301	33 (71.74)
HTN, n (%)	93 (92.8)	0.057	29 (87.88)	0.027	46 (100)
Diabetes mellitus, n (%)	19 (18.81)	0.066	6 (18.18)	0.152	15 (32.61)
Obesity, n (%)	28 (27.72)	0.946	10 (30.3)	0.844	13 (28.26)
Dyslipidemia, n (%)	50 (49.5)	0.586	12 (36.36)	0.114	25 (54.25)
Smoker, n (%)	14 (13.86)	0.578	4 (12.12)	0.752	8 (17.39)
eGFR ≤60 ml/min, n (%)	20 (19.8)	0.006	4 (12.12)	0.006	19 (41.3)
Previous MI, n (%)	43 (42.57)	0.005	18 (54.55)	0.246	31 (67.39)
Previous CABG, n (%)	6 (5.94)	1	0	0.261	3 (6.52)

\*p compared with ACS group.

ACS, acute coronary syndrome; HTN, hypertension; MI, myocardial infarction; CABG, coronary artery bypass grafting; eGFR, estimated glomerular filtration rate.

in baseline characteristics, risk factors, and comorbidities between the three groups.

Right coronary artery disease was more frequent in the acute coronary syndrome group than in the other two groups; however, the numbers of diseased vessels between the three groups at the index procedure or readmission were not different. Drug-eluting stent utilisation at index percutaneous coronary intervention was more frequent in the asymptomatic group. Bare metal stent in-stent restenosis and localisation of in-stent restenosis to the left descending artery occurred more often in the acute coronary

syndrome group than in the stable angina group or asymptomatic group (Table II).

## Discussion

Arterial chronic hypertension is a classical and well-known cardiovascular risk factor for the development of atherosclerosis and coronary artery disease. A previous study revealed a 63.4% prevalence of hypertension among acute coronary syndrome patients [1]. The impact of hypertension on patients with acute coronary syndrome is related to the progression of coronary atherosclerosis and favours the

Table II. Intervention features

		Stable angina group		Asymptomatic group		ACS group
		N (%)	p*	N (%)	p*	
Number of diseased vessels at index PCI	1	50 (49.5)	0.301	10 (30.3)	0.279	18 (39.13)
	2	32 (31.68)		15 (45.45)		16 (34.78)
	3	16 (15.84)		6 (18.18)		12 (26.09)
	>3	3 (2.97)		2 (6.06)		0
Lesion localisation at index PCI	LMCA	3 (2.97)	0.377	0	0.261	3 (6.52)
	LAD	70 (69.31)	0.569	24 (72.37)	0.906	34 (73.91)
	RCA	40 (39.6)	0.056	19 (57.58)	0.926	26 (56.52)
	LCX	35 (34.65)	0.808	10 (30.3)	0.828	15 (32.61)
	Other coronary artery	24 (23.76)	0.385	11 (33.33)	0.102	8 (17.39)
Time interval between index PCI and readmission (mean ± median), months		27.68 ± 29.66	0.07	24.33 ± 35.12	0.09	37.86 ± 35.52
Number of diseased vessel at readmission	0	45 (44.55)	0.087	15 (45.45)	0.142	11 (23.91)
	1	37 (36.63)		14 (42.42)		21 (45.65)
	2	14 (13.86)		3 (9.09)		10 (21.74)
	3	5 (4.95)		1 (3.03)		4 (8.7)
Lesion localisation at readmission	LMCA	2 (1.98)	0.589	0	0.507	2 (4.35)
	LAD	22 (21.78)	0.161	6 (18.18)	0.152	15 (32.61)
	RCA	22 (21.78)	0.028	6 (18.18)	0.046	18 (39.13)
	LCX	7 (6.93)	0.226	5 (15.15)	1	6 (13.04)
	Other coronary artery	21 (20.79)	0.476	6 (18.18)	0.409	12 (26.09)
Stent type at index PCI	DES	34 (33.66)	0.081	16 (48.48)	0.006	9 (19.57)
	BMS	77 (76.24)	0.239	23 (69.7)	0.108	39 (84.78)
DES ISR, n (%)		4 (3.96)	0.258	0	0.136	4 (8.7)
BMS ISR, n (%)		34 (33.66)	0.033	6 (18.18)	0.002	24 (52.17)
BMS ISR localisation	LMCA	10 (9.9)	0.052	1 (3.03)	0.021	10 (21.47)
	RCA	8 (7.92)	1	2 (6.06)	1	3 (6.52)
	LCX	6 (5.94)	1	1 (3.03)	0.636	3 (6.52)
	Other coronary artery	3 (2.97)	0.648	1 (3.03)	1	2 (4.35)

\*p compared with ACS group.

LMCA, left main coronary artery; LAD, left descending artery; RCA, right coronary artery; LCX, left circumflex coronary artery; DES, drug-eluting stent; BMS, bare metal stent; ISR, in-stent restenosis.

development of vulnerable atherosclerotic plaques through which rupture can occur during acute coronary syndrome. The prognoses of patients with known hypertension and acute coronary syndrome are also impaired. In the Kamir registry, a history of hypertension was related to higher in-hospital mortality [2]. In the GISSI-2 study, in-hospital and 6-month mortality rates were higher for hypertensive patients than for normotensive myocardial infarction patients [3].

Chronic kidney disease is associated with accelerated atherosclerosis and is a predictor of cardiovascular morbidity, mortality, and all-cause mortality for patients with acute coronary syndrome [4,5]. Mechanisms related to the adverse outcomes are more severe vessel disease on presentation with acute coronary syndrome [4], differences in coronary plaque morphology [6], less aggressive revascularization, and medical therapy.

The superiority of drug-eluting stents compared to bare metal stents regarding target lesion revascularisation has been investigated in many studies. In NORSTENT, the largest randomised study to compare contemporary drug-eluting stents and bare metal stents, target lesion revascularisation and definite stent thrombosis were significantly lower for drug-eluting stent patients than for bare metal stent patients [7]. Furthermore, in our study, bare metal stent in-stent restenosis was more frequent than drug-eluting stent in-stent restenosis in the acute coronary syndrome group. These findings raise the question of the utility of bare metal stents in the era of drug-eluting stents and bioabsorbable vascular stents. High haemorrhagic risk and inadequate dual antiplatelet therapy may be reasons why bare metal stents are preferred to drug-eluting stents.

The localisation of bare metal stent in-stent restenosis was not unusual because tortuosity and angulation of the left descending coronary artery can predispose patients to accelerated progression of atherosclerosis [8,9].

Right artery disease was more frequent in the acute coronary syndrome group than in the other two groups at readmission. This raised the hypothesis of incomplete revascularisation at index percutaneous coronary intervention or progression of atherosclerosis after index percutaneous coronary intervention.

### Study limitations

Our study had several limitations. First, the data were retrospectively extracted by reviewing medical observation files and depended on the accuracy and completeness of them. Second, the study included only patients admitted to our clinic. Patients admitted to other hospitals or who

died were not included in our study. Finally, the time interval between index percutaneous coronary intervention and readmission has not been standardized. However, the average time interval for each group was not statistically significant.

### Conclusion

Hypertension and impaired renal function are clinical risk factors for acute coronary syndrome. Right coronary artery disease, bare metal stent in-stent restenosis, and left descending artery localisation of bare metal stent in-stent restenosis are angiographic risks associated with acute coronary syndrome. Recognition and treatment, particularly of preventable factors, may improve the outcomes and prognoses of coronary disease patients after successful percutaneous coronary intervention.

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### Conflict of interest

None to declare.

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