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Clinical pattern, Angiographic findings and Immediate Percutaneous Coronary Intervention outcome in Elderly Patients of more than seventy years old versus a younger patient in a case control study

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Abstract
Background: The aged population has grown significantly in recent decades, and ischemic heart disease (IHD) is a primary cause of morbidity and death globally. Many elderly individuals have several cardiovascular risk factors, substantial coronary artery involvement, unique clinical presentations, and an increased risk of consequences. Percutaneous coronary intervention (PCI) is commonly utilized to treat IHD, however older patients' results are still of interest.
Objective: To assess in-hospital outcomes of PCI in elderly patients and compare them with outcomes in a younger age group.
Patients and Methods: This prospective observational study was conducted between January 1, 2021, and January 20, 2022, and included 200 patients with IHD who underwent PCI at four Iraqi cardiovascular centers. Patients were purposively selected and divided into two age-based groups: <70 years (n=100) and ≥70 years (n=100). Baseline demographic data, cardiovascular risk factors, angiographic findings, indications for PCI, and in-hospital outcomes were recorded and analyzed.
Results: Age significantly correlated with gender, diabetes, hypertension, smoking, chronic renal disease, COPD, and past stroke ($p \leq 0.05$). Angiographic abnormalities related with older age included left main stem disease (p=0.013) and calcified coronary arteries (p=0.001). NSTEMI was more common in older individuals than STEMI and cardiogenic shock in younger patients. Slow flow phenomena (11%), post-PCI left ventricular dysfunction (11%), and contrast-induced nephropathy (24%), were more common in the elderly. Younger patients had 4% in-hospital mortality and older patients 2%.
Conclusion: Without age restrictions, older patients can have elective and urgent PCI safely. Elderly individuals are more likely to develop contrast-induced nephropathy and post-PCI left ventricular dysfunction, but these risks may be manageable. PCI mortality predictors were comparable in both age groups.

Keywords: Clinical, pattern, Angiographic, Immediate, Percutaneous, Coronary, Intervention, Elderly

Introduction
The global population of older adults is expanding rapidly, leading to a growing burden of age-related diseases. In the United States, the population aged ≥65 years increased from approximately 3 million in 1900 to nearly 46 million in recent years and is projected to reach almost 84 million by 2050 [1, 2]. Prolonged life expectancy results in extended exposure to cardiovascular risk factors, producing cumulative vascular and myocardial damage over time. Consequently, cardiovascular disease (CVD) remains the leading cause of morbidity and mortality among elderly individuals worldwide. Age is one of the most important non-modifiable risk factors for coronary artery disease (CAD), which represents a major cause of death in older populations [3]. Patients aged ≥70 years' account for nearly 40% of deaths attributable to ischemic heart disease (IHD) [4]. Aging is associated with complex structural and functional cardiovascular changes, including arterial stiffening, endothelial dysfunction, increased intima-media thickness, myocardial fibrosis, and impaired diastolic function. These changes are mediated by cellular senescence, neurohormonal activation, inflammatory

cytokine release, and upregulation of the renin-angiotensin-aldosterone system, all of which predispose elderly individuals to CAD, myocardial ischemia, and heart failure [5, 6]. The prevalence of CAD increases markedly with advancing age. According to World Health Organization estimates, cardiovascular diseases account for approximately 31% of all global deaths, with coronary artery disease and stroke being the principal contributors [7]. In elderly populations, CAD is frequently accompanied by comorbid conditions such as hypertension, diabetes mellitus, chronic kidney disease, cerebrovascular disease, and frailty, all of which adversely affect prognosis and complicate management [8]. Coronary lesions in elderly patients tend to be more complex, characterized by extensive calcification, multivessel involvement, tortuosity, and left main coronary artery disease, increasing procedural difficulty and risk during revascularization [9-10]. Percutaneous coronary intervention (PCI) is an established therapeutic strategy for the management of stable coronary disease and acute coronary syndromes. However, advanced age has historically been associated with higher rates of PCI-related complications and worse short-term outcomes [11, 12]. Despite this, advances in interventional techniques, drug-eluting stents, pharmacotherapy, and transradial access have significantly improved procedural success and safety in elderly patients [13, 14]. Current ACC/AHA and ESC guidelines emphasize that age alone should not preclude invasive management, including PCI, in appropriately selected elderly patients presenting with either ST-elevation or non-ST-elevation acute coronary syndromes [15, 16] The aim of this study is to clarify the clinical presentation, coronary angiographic patterns, and in-hospital complications of percutaneous coronary intervention in patients aged ≥70 years, and to compare these outcomes with those observed in younger patients.

Method

A prospective observational study was conducted from January 1, 2021, to January 20, 2022 in four Iraqi cardiac centers: Ibn Albitar Center for Cardiac Surgery, Baghdad Cardiac Center, Iraqi Center for Heart Disease, and Al-Najaf Center for Cardiac Surgery. The study planned to enroll 200 patients with ischemic heart disease (IHD) undergoing percutaneous coronary intervention (PCI), divided into two age-based groups: ≥70 years (elderly group, n=100) and <70 years (control group, n=100). Data were collected using a structured questionnaire designed according to relevant literature and guidelines. Information was obtained through direct interview and review of clinical records. Baseline variables included age, sex, cardiovascular risk factors and comorbidities (diabetes mellitus, hypertension, smoking, chronic kidney disease, chronic obstructive pulmonary disease, peripheral arterial disease, prior PCI, prior CABG, and prior stroke), in addition to drug history. Clinical presentation was categorized as STEMI, NSTEMI, unstable angina, stable IHD, cardiogenic shock, or arrhythmia. PCI indications and angiographic interpretation were determined by the responsible consultant according to current practice guidelines. Pre-catheterization assessment included ECG, echocardiography, CBC, fasting blood sugar, blood urea, serum creatinine with calculated GFR, viral screening, and cardiac enzymes; samples were analyzed in hospital laboratories using standardized methods. All patients received loading with clopidogrel or ticagrelor, and unfractionated heparin bolus (60-70 U/kg) during the procedure. PCI was classified as elective or emergency, with procedures including predilatation ballooning, drug-eluting ballooning, and drug-eluting stent implantation. Femoral access was most frequently used due to limited radial materials; all punctures were closed by manual compression. Outcomes included major bleeding (hemoglobin drop >5 g/dL or hematocrit drop >15%), vascular access complications, post-PCI LV dysfunction (clinical and bedside echocardiography), contrast-induced nephropathy (creatinine rise ≥0.5 mg/dL or ≥25% within 48-72 h), arrhythmia (ECG monitoring), stent thrombosis, stroke, acute limb ischemia, procedural success (TIMI 3 flow and residual stenosis <20%), and in-hospital mortality. Ethical approval was obtained from the Iraqi Board for Medical Specialization. Verbal informed consent was obtained from all participants. Data were analyzed using SPSS v23; categorical variables were presented as frequencies/percentages and continuous variables as mean±SD. Associations were tested using chi-square, with $p \leq 0.05$ considered significant.

Results

Gender, Diabetis mellitus (DM), hypertension (HT), Smoking, chronic kidney disease(CKD), COPD and prior stroke were associated significantly with patients age ($p \leq 0.05$). The difference in comorbid disease were shown in table 1.

Table 1: Baseline characteristics of the studied group

Variables		Patients age in years		Total	P value
		Patient studied group(≥70 years)	Control group (<70 years)		
Age	Mean SD	73.1 4.1	58.5 8.1	200	
Gender	Male	62	78	140(70%)	0.014*
	Female	36	22	60(30%)	
DM	Positive	59	42	101(50.5%)	0.016*
	Negative	41	58	99(49.5%)	
HT	Positive	75	52	127(63.5%)	0.001*
	Negative	25	48	73(36.5%)	
Smoking	Non	85	62	147(73.5%)	<0.001*
	Smoked	15	38	53(26.5%)	
CKD	Positive	23	12	35(17.5%)	0.041*
	Negative	77	88	165(82.5%)	
COPD	Positive	4	0	4(2%)	0.043*
	Negative	96	100	196(98%)	
PAD	Positive	0	2	2(1%)	0.155*

	Negative	100	98	198(99%)	
Prior MI	Positive	10	4	14(7%)	0.096*
	Negative	90	96	186(93%)	
EF	>50%	63	82	145(72.5%)	0.003*
	≤50%	37	18	55(27.55)	
Prior stroke	Positive	7	0	7(3.5%)	0.007*
	Negative	93	100	193(96.5%)	
Prior PCI	Positive	20	17	37(18.5%)	0.58*
	Negative	80	83	163(81.5%)	
Prior CABG	Positive	0	1	1(0.5%)	0.31*
	Negative	100	99	199(99.5%)	
Total		100	100	100	

*Chi-square test, significant ≤0.05.

The difference in presentation of patients in relation to patients age where shown in table (2). With only cardiogenic shock shown a significant association with the younger patients (p=0.013) other shown no significant association with elderly patients. (p>0.05).

Table 2: Difference of patient's presentation according to studied group

Presentation		**Patients age in years**		**Total**	**P value**
		≥ 70 years	**<70 years**		
STEMI	Positive	29	32	61(30.5%)	0.64*
	Negative	71	68	139(69.5%)	
NSTEMI	Positive	10	6	16(8%)	0.29*
	Negative	90	94	184(92%)	
Unstable angina	Positive	26	26	52(26%)	1*
	Negative	74	74	148(74%)	
Stable IHD	Positive	30	28	58(29%)	0.75*
	Negative	70	72	142(71%)	
Cardiogenic shock	Positive	0	6	6(3%)	0.013*
	Negative	100	94	194(97%)	
Arrhythmia	Positive	8	6	14(7%)	0.57*
	Negative	92	94	186(93%)	
Total		100	100		

*Chi-square test, significant ≤0.05.

The angiographic finding that shown a significant association with patients age were left main stem (p=0.013) and calcified vessels (p=0.001) while other finding shown no significant association with patients age (p>0.05), table 3.

Table 3: Distribution of angiographic finding according to studied group

Angiographic finding		**Patients age in years**		**Total**	**P value**
		≥ 70 years	**<70 years**		
Single vessel involvement	Present	36	38	74(37%)	0.77*
	Negative	64	62	126(63%)	
Double vessel involvement	Present	42	46	88(44%)	0.56*
	Negative	58	54	112(56%)	
triple vessel involvement	Present	20	14	34(17%)	0.25*
	Negative	80	86	166(83%)	
Left main stem	Present	4	14	18(9%)	0.013*
	Negative	96	86	182(91%)	
Chronic total obstruction	Present	11	6	17(8.5%)	0.2*
	Negative	89	94	183(91.5%)	
Calcified vessel	Present	22	2	24(12%)	0.001*
	Negative	78	98	176(88%)	
Total		100	100	200	

*Chi-square test, significant ≤0.05.

Three complications that were significantly (P<0.05) associated with the age were (LV dysfunction, contrast-induced nephropathy and slow flow) while the others were not significantly (P>0.05) associated with the age) as in the table 4.

Table 4: Difference in complication according to patients age

Complication		Patients age in years		Total	P value
		≥70 yrs	<70 yrs		
Hemorrhage	Developed	2	2	4(2%)	1*
	Not developed	98	98	196(98%)	
Hematoma	Developed	7	6	13(6.5%)	0.77*
	Not developed	93	94	187(93.5%)	
Dissection	Developed	8	8	16(8%)	1*
	Not developed	92	92	184(92%)	
Perforation	Developed	2	4	6(3%)	0.407*
	Not developed	98	96	194(97%)	
Thrombosis	Developed	2	4	6(3%)	0.407*
	Not developed	98	96	194(97%)	
CIN	Developed	24	8	32(16%)	0.002*
	Not developed	76	92	168(84%)	
Post PCI LV dysfunction	Developed	11	0	11(11%)	0.001*
	Not developed	89	100	189(94.5%)	
Arrhythmia	Developed	12	8	20(10%)	0.34*
	Not developed	88	92	180(90%)	
Acute limb ischemia	Developed	0	0		1*
	Not developed	100	100	200(100%)	
Slow flow	Developed	13	2	15(7.5%)	0.003*
	Not developed	87	98	185(92.5%)	
Death	Developed	2	4	6(3%)	0.407*
	Not developed	98	96	194(97%)	
Total		100	100	200	

*Chi-square test, significant ≤0.05.

The development of procedural complication was associated significantly with patients age (p=0.003), where 55 patients with age ≥70 years developed complication where only 34 patients with age <70 years developed complication, figure 1.

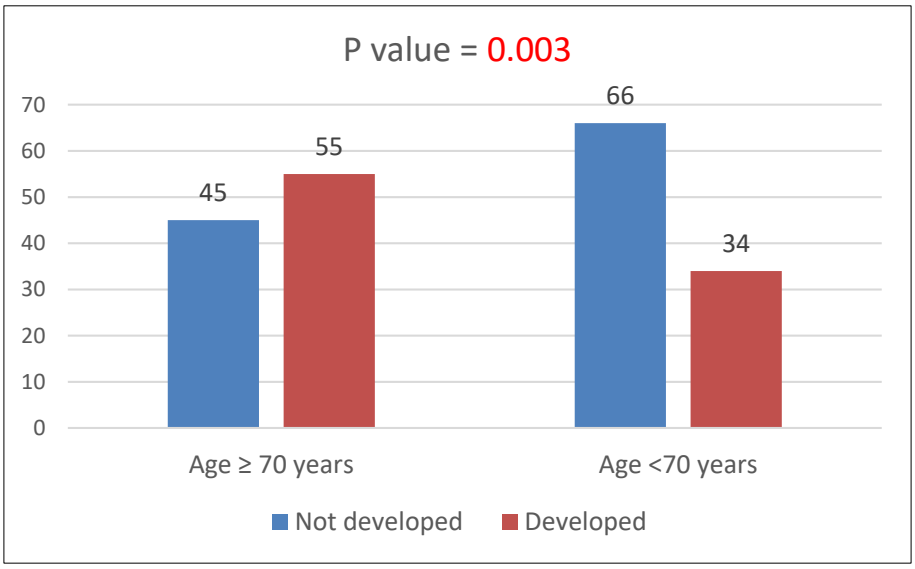

Fig 1: Rate of procedural complications with patients age.

In hospital mortality shown a significant association with EF% at presentation while other comorbidity shown no significant association, as in table 5.

Table 5: Association of in hospital mortality with patient comorbidity.

Variables		In hospital mortality No (%)	P value
Gender	Male	4(66.7%)	0.85*
	Female	2(33.3%)	
DM	Positive	4(66.7%)	0.68*
	Negative	2(33.3%)	
HT	Positive	6(100%)	0.088*
	Negative	0	
Smoking	Non	6(100%)	0.34*
	Smoked	0	

CKD	Positive	1(16.7%)	0.95*
	Negative	5(83.3%)	
COPD	Positive	0	0.72*
	Negative	6(100%)	
PAD	Positive	0	0.8*
	Negative	6(100%)	
Prior MI	Positive	0	0.59*
	Negative	6(100%)	
EF	>50%	2(33.3%)	0.029*
	≤50%	4(66.7%)	
Total		6	

*Chi-square test, significant ≤0.05.

In hospital mortality shown a significant association with STEMI at presentation, cardiogenic shock and arrhythmia while other presentation shown no significant association, as in table 6.

Table 6: Association of in hospital mortality with patient presentation.

Presentation		In hospital mortality No (%)	P value
STEMI	Positive	6(100%)	0.001*
	Negative	0	
NSTEMI	Positive	0	0.46*
	Negative	6(100%)	
Unstable angina	Positive	0	0.34*
	Negative	6(100%)	
Stable IHD	Positive	0	0.18*
	Negative	6(100%)	
Cardiogenic shock	Positive	4(66.7%)	0.001*
	Negative	2(33.3%)	
Arrhythmia	Positive	4(66.7%)	0.001*
	Negative	2(33.3%)	
Total		6 (100%)	

*Chi-square test, significant ≤0.05.

In hospital mortality shown a significant association with double & triple vessel involvement, left main stem and slow flow while other complication shown no significant association. As in table 7.

Table 7: Association of in hospital mortality with the type of Vessels involvement

Angiographic finding		**In hospital mortality No (%)**	**P value**
Single vessel involvement	Present	2(33.3%)	0.85*
	Negative	4(66.7%)	
Double vessel involvement	Present	0	0.036*
	Negative	6(100%)	
triple vessel involvement	Present	4(66.7%)	0.008*
	Negative	2(33.3%)	
Left main stem	Present	4(66.7%)	0.001*
	Negative	2(33.3%)	
Chronic total obstruction	Present	0	0.44*
	Negative	6(100%)	
Calcified vessel	Present	0	0.35*
	Negative	6(100%)	
Slow flow	Present	4(66.7%)	0.001*
	Negative	2(33.3%)	
Total		6(100%)	

Discussion

In the present study, patients were divided into two age-based groups to evaluate PCI-related complications during and after the procedure and to assess the extent to which age acts as a predisposing factor. Historically, interventional therapy was often avoided in elderly patients with ischemic heart disease because of vascular complexity, frailty, and multiple comorbidities. However, contemporary evidence increasingly supports PCI in carefully selected elderly patients. Contrast-induced nephropathy (CIN) was one of the most prominent complications, with an overall incidence of 16%, rising to 24% in the elderly compared with 8% in younger patients. This aligns with evidence identifying age >70 years as an independent predictor of CIN, likely due to reduced glomerular filtration rate, impaired tubular function, multivessel disease, and comorbidities [17, 18]. Our results showed only modest differences in baseline characteristics between groups. NSTEMI was more common among elderly patients, whereas STEMI predominated in younger patients, a finding consistent with previous studies and possibly explained by less-developed collateral circulation in younger individuals [19]. Angiographically, elderly patients more frequently exhibited left main stem disease, triple-vessel disease, calcified lesions, and chronic total

occlusions, reflecting the advanced and diffuse nature of atherosclerosis with aging. Compared with Rahman *et al.* [20], who reported a CIN rate of 6%, the higher incidence in our study may be explained by the inclusion of patients with baseline renal dysfunction. Chen *et al.* [21] reported a much lower CIN incidence, possibly related to routine radial access and aggressive preventive measures [22]. Post-PCI left ventricular (LV) dysfunction occurred in 11% of elderly patients but was absent in younger patients. This may be attributed to age-related decline in cardiomyocyte regeneration, baseline LV dysfunction, larger infarct size, delayed reperfusion, multivessel disease, and higher creatinine levels [23]. A comparable incidence was reported by Rahman *et al.* [20], with differences likely reflecting variations in ACS burden and CKD prevalence. Femoral access was predominantly used (97.5%), reflecting resource limitations. Although femoral access is associated with higher bleeding risk in the elderly [24], our study showed low rates of minor bleeding (2%) and femoral hematoma (6.5%), comparable or lower than previously reported series [25, 26], possibly due to careful patient selection and manual compression. Slow-flow phenomenon was observed in 7.5%, predominantly among elderly patients, and was significantly associated with adverse outcomes. Although lower than rates reported in primary PCI-focused studies [25, 27], slow flow remains an important predictor of morbidity and mortality [28]. Arrhythmias occurred more frequently in elderly patients but without statistical significance, similar to prior reports [21]. Overall in-hospital mortality was low (3%) and did not differ significantly between age groups, consistent with several regional and international studies [20-29]. Mortality was strongly associated with multivessel disease, LV dysfunction, STEMI, cardiogenic shock, arrhythmia, and slow flow, rather than age alone. These findings support the growing consensus that PCI can be safely performed in elderly patients, with outcomes primarily driven by clinical and angiographic risk profiles rather than chronological age itself [21-23].

Conclusion

PCI in elderly with can be done cautiously wither it is an elective or an emergency. The elderly more liable to develop some complications like CIN and post PCI Lv Dysfunction which can be modify. The multivariable regression analysis of mortality of PCI are same in both age group.

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