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In-Hospital and Short-Term Outcomes of Percutaneous Coronary Intervention in Patients Older Than 65 Years Old: Results from Tanta PCI Registry

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Percutaneous coronary intervention (PCI) outcomes in elderly people are more challenging due to several factors. This study aimed to investigate in-hospital and short-term outcomes of PCI in elderly people aged more than 65 years old, presented to cardiology department of Tanta university hospitals during study period.
Methods: This case-control study was carried out on 935 patients presenting for elective PCI procedure and those suffering from high-risk ACS either ST segment elevation myocardial infarction (STEMI), non-ST segment elevation myocardial infarction (NSTEMI) or unstable angina treated with urgent PCI. Patients were divided into 4 groups: group II: included 326 patients aged from 65 to 69 years old, group III: included 160 patients aged from 70 to 74 years old, group IV:

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Included 99 patients aged ≥ 75 years old and group I (control): included 350 patients aged < 65 years old. All patients were subjected to ECG, echocardiography, basic labs, coronary angiography and PCI.

Results: Mortality, dissection, perforation, CIN, hemorrhage, heart failure and cardiogenic shock were significantly different among STEMI patients' groups (P ≤ 0.05). CVS, Heart failure and Cardiogenic shock were significantly different among NSTE-ACS patients' groups (P ≤ 0.05). Loss of follow up and mortality were significantly different among NSTE-ACS patients' groups. Age, diabetes mellitus, hypertension, multi-vessel diseases, dissection, perforation and major bleeding were significant predictors of mortality among elective PCI patients (P ≤ 0.05). Age, diabetes mellitus, hypertension, chronic kidney diseases that necessitates dialysis, dyslipidemia multi-vessel diseases, left main artery, final TIMI 0, final TIMI I dissection, perforation, and major bleeding were significant predictors of mortality among ACS PCI patients (P ≤ 0.05).

Conclusions: In spite that PCI in elderly people still challenging, with poorer outcomes especially among those older than 75 years of age, newer generations of drug-eluting stents, and wide-availability of the safer radial artery access reduced the risk of PCI-related major adverse cardiovascular events and improved the long-term clinical outcomes in elderly patients suffering from both high-risk chronic and ACS.

Keywords: Percutaneous coronary intervention; myocardial infarction; acute coronary syndrome; sepsis.

1. INTRODUCTION

Coronary artery disease (CAD) is defined as narrowing of coronary arteries caused by accumulation of atherosclerotic fatty plaques in the walls of the coronaries with variable degrees of affection. This pathological process is facilitated by existence of risk factors such as old age, diabetes mellitus, hypertension, smoking and dyslipidemia [1].

Elderly people had greater prevalence of coronary risk factors especially, hypertension and diabetes. Consequently, they are more prone to acute coronary syndromes (ACS) and recurrent attacks of myocardial infarction with increased incidence of various complications, most prominently reduced left ventricular ejection fraction (EF) <50% [2].

There are enormous research data indicating that in-hospital, short-term 30-day and long-term follow-ups showed higher morbidity and all-cause mortality in elderly people suffering from CAD in comparison to their non-elderly counterparts [2].

Elderly people are still susceptible to a tangible higher risk for early and late cardiovascular complications, reducing their long-term survival. That increased risk may be referred to having more complex lesion characteristics and extensibility [3].

In spite that age in general is inversely proportional to survival of elderly patients, particularly those above 75 years old, age on its own should not be an exclusive reason to deprive patients from undergoing percutaneous coronary intervention (PCI) when indicated. Using a standardized protocol can improve survival in the elderly because it ensures using best practices with resorting to invasive hemodynamic monitoring and support when indicated [3].

In a special vulnerable category of elderly people, the extremely old females suffering from ACS, timely PCI procedure mitigated the risks of MACCE and additionally improved the survival and long-term clinical outcomes especially with the use of new generations of the drug-eluting stents (DES) which is more effective and doesn't expose the patient to bleeding risks due to prolonged dual anti-platelets therapy [4].

Subsequently, aggressive PCI strategy if indicated, should be provided for treating this population, but special considerations should be paid to all factors that might impact post-PCI clinical prognosis [4]. Special focus should be on elderly people's higher incidence of target lesion failure, recurrent myocardial infarction indicating revascularizations [5].

In developing countries like Egypt, PCI outcomes in elderly people are more challenging due to several factors such as, lesser awareness about atypical presentation of acute and chronic coronary syndromes in elderly people [6] and limited availability of state-of-the-art equipment.

The aim of this work was investigated in-hospital and short-term outcomes of PCI in elderly people aged more than 65 years old, presented to cardiology department of Tanta university hospitals during study period.

2. PATIENTS AND METHODS

This case-control study was carried out on 935 patients presenting for elective PCI procedure and those suffering from high-risk ACS either STEMI, NSTEMI and unstable angina treated with urgent PCI within 24 hours of their presentation at Cardiovascular Medicine Department at Tanta University Hospitals. The study was conducted for 24 months starting from December 2019.

Exclusion criteria were patients in whom the diagnostic coronary angiography study was deemed normal or not indicating undergoing angioplasty, patients in whom PCI risks outweigh benefits (active bleeding from non-compressible site, chronic kidney disease on medical treatment with s.creatinine >3.0, decompensated Liver failure, metastatic malignancy) and confirmed Covid-19 cases or those highly suspected for Covid-19 by radiological CT chest criteria, clinical and laboratory data according to hospital protocol during the epidemic.

Patients were divided into 4 groups according to their age: group II (case group): included 326 patients aged from 65 to 69 years old, group III (case group): Included 160 patients aged from 70 to 74 years old, group IV (case group): Included 99 patients aged ≥ 75 years old and group I (control group): Included 350 patients aged < 65 years old.

All patients were subjected to history taking, clinical examination such as vital signs and signs of heart failure or hemodynamic instability according to Killip classification for myocardial infarction patients (Killip class I includes individuals with no clinical signs of heart failure, killip class II includes individuals with rales or crackles in the lungs, an S3, and elevated jugular venous pressure, killip class III describes individuals with frank acute pulmonary edema, killip class IV describes individuals with cardiogenic shock or hypotension) [7], local heart examinations (apical impulse, abnormal pulsation, heart sounds and murmurs) and laboratory investigations (cardiac enzymes (troponin and CKMB) for ACS on admission, within 6 hours and 24 hours, complete blood count (CBC), repeated post-procedure in patients suffering from hemorrhagic complications, lipid profile, liver function tests (ALT, AST, albumin, prothrombin time), random blood sugar, serum urea and creatinine and virology (HIV, HCV antibodies and HBV antigens). Standard 12-lead ECG was obtained within five to ten minutes of first medical contact [8].

2.1 Pre-Procedural Medications

All patients received a loading dose of Aspirin 300 mg and clopidogrel 600 mg or ticagrelor 180 mg. Intravenous administration of Unfractionated Heparin with a dose of 70–100 U/kg was given when no glycoprotein (GP) IIb/IIIa inhibitor was used and 50–60 U/kg with the use of GP IIB/IIIa inhibitor [9].

2.2 PCI Procedure [9]

Diagnostic coronary angiography was performed via Philips and Siemens systems at our two cath labs in Tanta university hospitals. Access site was mainly trans-radial approach, which was prioritized in the majority of patients rather than trans-femoral one, with implementation of standard techniques for both approaches. Intraprocedural medications were given as soon as the arterial sheath is in place, with a dose of UFH 60 unit/kg with additional doses of IV heparin every 30 minutes during the procedure. GP IIb/IIIa inhibitors (eptifibatide or tirofiban) was administrated for selected patient via intra-coronary or intra-venous root during urgent PCI procedure followed by continuation of IV infusion post- procedure for 24 hours in most cases [10].

Culprit lesion(s) were assessed regarding the occlusion site, severity, side branch affection, presence of thrombus & thrombotic burden (TIMI flow grade) [11]. Multi-vessel disease (MVD) was defined as presence of ≥ 1 lesion with >70% stenosis in more than one major epicardial coronary artery or its sizable branches [12].

Reperfusion success is assessed by low residual stenosis as shown by angiography, However in ACS cases, reperfusion was assessed by TIMI flow scoring: successful (TIMI 3) or abnormal (TIMI 0-1-2) [TIMI flow grade (0) No perfusion; no antegrade flow beyond the point of occlusion, TIMI flow grade (1) faint antegrade coronary flow beyond the occlusion with incomplete filling of the distal coronary bed., TIMI flow grade (2) sluggish antegrade flow with complete filling of the distal circulation, TIMI flow grade (3) complete filling of the distal bed] [13].

Angiographic complications were assessed which included distal embolization (inadvertent distal displacement of a filling defect to causing abrupt distal cut-off or circumscribed filling defect in the main vessel or its branches), no reflow (TIMI flow grade <1 not explained by dissection, spasm nor lesion thrombus [13], dissection (A radiolucent defect within the lumen of the vessel) and perforation (extravasation of contrast from the artery mainly to the pericardial space).

Post-PCI care were access site care and early detection of related vascular complications, monitoring of patients in a coronary care unit that has continuous ECG telemetry by A 12 lead ECG that was obtained after PCI, medications such as aspirin forever (75-100 mg/d) for all patients without allergy, clopidogrel 150 mg/d for 14 days then 75 mg/d or ticagrelor 90 mg twice daily for all patients for about 12 months, beta-blockers in all patients with highest tolerable dose, ACE-I or ARBS and spironolactone when indicated, high-dose statins irrespective of cholesterol levels and nitrate, nicorandil according to individualization.

Clinical outcomes during hospital stay and after three-month follow-up were either primary outcome that included in-hospital mortality and death within 3-months of procedure or secondary outcomes such as cerebrovascular stroke including ischaemic and hemorrhagic, congestive heart failure and cardiogenic shock, recurrent myocardial infarction, re-intervention, urgent CABG, access site vascular complications (hematoma, hemorrhage, thrombosis and limb ischaemia), contrast-induced nephropathy (CIN), gastro-intestinal bleeding.

2.3 Statistical Analysis

The analysis was calculated by SPSS software package version 25. The qualitative parameters were described by number of frequency and percentage while the quantitative variables were described by mean, standard deviation and range. Normality of qualitative variables was tested by Kolmogorov-Smirno test. The comparison of independent quantitative variables was calculated by T independent test. The comparison between two qualitative variables was done by Chi square, Fisher's exact fisher and MonteCarlo tests. Risk estimate was evaluated by odds ratio with 95% confidence interval.

3. RESULTS

Table 1 shows classification of the study patients into groups according to their age.

Table 1. Classification of the study patients into groups according to their age

Group	Age	N (%)
Group I (control)	< 65	350 (37.4 %)
Group II	65-69	326 (34.9 %)
Group III	70-74	160 (17.1 %)
Group IV	≥ 75	99 (10.6 %)

Data is presented as frequency (%)

Mortality, dissection, perforation, CIN, hemorrhage, heart failure and cardiogenic shock were significantly different among STEMI patients' groups (P ≤ 0.05). CVS, Heart failure and Cardiogenic shock were significantly different among NSTE-ACS patients' groups (P ≤ 0.05) Table 2.

Loss of follow up and mortality were significantly different among NSTE-ACS patients' groups Table 3.

Age, diabetes mellitus, hypertension, multi-vessel diseases, dissection, perforation and major bleeding were significant predictors of mortality among elective PCI patients. Table 4

Age, diabetes mellitus, hypertension, chronic kidney diseases (CKD) that necessitates dialysis, dyslipidemia multi-vessel diseases, left main artery, final TIMI 0, final TIMI I dissection, perforation, and major bleeding were significant predictors of mortality among ACS PCI patients (P ≤ 0.05) Table 5.

4. DISCUSSION

With regards to in-hospital adverse events complicating elective PCI in this study, mortality occurred in about 2.6% of all elective patient, with the highest level recorded in the oldest group IV (>75 years. old) in which death occurred to 6.7% of patients and the lowest in the control group <65 years of age which mortality were faced in 1.3%. This percentage is comparable to mortality level in Papapostolou et al. [4] study which was 5.2% in case group and 1.3% in control group. The in-hospital mortality figure was better in Lian et al. [14] study, as it was only 1.1%, and in Ramakrishna et al. [15] study, with mortality rate = 1.7%.

Acute stent thrombosis was scarce among elective PCI population in this study, recording only 0.8%, which is similar to the results of Papapostolou et al. [4] study, 0.3%.

Table 2. In-hospital adverse events among study elective PCI, STEMI and NSTE-ACS patients' groups

Major in-hospital adverse Events		Elective PCI (n=383)				P
		Group VI (control) (n=150)	Group I (n=137)	Group II (n=66)	Group III (n=30)	
		N (%)	N (%)	N (%)	N (%)	
Mortality		2 (1.3 %)	3 (2.2 %)	3 (4.5 %)	2 (6.7 %)	0.265
Acute stent thrombosis		2 (1.3 %)	1 (0.7 %)	0 (0.0 %)	0 (0.0 %)	0.718
CVS		0 (0.0 %)	0 (0.0 %)	1 (1.5 %)	1 (3.3 %)	0.062
Dissection		7 (4.7 %)	7 (5.1 %)	4 (6.1 %)	3 (10.0 %)	0.696
Perforation		2 (1.3 %)	3 (2.2 %)	2 (3.0 %)	3 (10.0 %)	0.056
CIN		6 (4 %)	6 (4.4 %)	5 (7.6 %)	3 (10.0 %)	0.428
limb ischemia		2 (1.3 %)	1 (0.7 %)	1 (1.5 %)	1 (3.3 %)	0.721
Non-major bleeding		11 (7.3 %)	10 (7.3 %)	5 (7.6 %)	5 (16.7 %)	0.634
Major bleeding		5 (3.3 %)	5 (3.6 %)	2 (3.0 %)	2 (6.7 %)	
Major in-hospital adverse Events		STEMI				P
		Group I (n=120)	Group II (n=108)	Group III (n=50)	Group IV (n=47)	
		N (%)	N (%)	N (%)	N (%)	
Mortality		4 (3.3%)	7 (6.5%)	7 (14.0%)	7 (14.9%)	0.022*
Acute stent thrombosis		2 (1.7%)	1 (0.9%)	1 (2.0%)	0 (0.0%)	0.777
CVS		0 (0.0%)	3 (2.8%)	2 (4.0%)	3 (6.4%)	0.087
Dissection		5 (4.2%)	7 (6.5%)	9 (18.0%)	8 (17.0%)	0.005*
Perforation		2 (1.7%)	3 (2.8%)	4 (8.0%)	5 (10.6%)	0.032*
CIN		6 (5.0%)	7 (6.5%)	7 (14.0%)	9 (19.1%)	0.018*
limb ischemia		1 (0.8%)	1 (0.9%)	2 (4.0%)	3 (6.4%)	0.087
Hemorrhage	No bleeding	112 (92.6%)	91 (85.0%)	40 (80.0%)	33 (70.2%)	0.024*
	Non major bleeding	6 (5.0%)	12 (11.2%)	7 (14.0%)	10 (21.3%)	
	Major bleeding	3 (2.5%)	4 (3.7%)	3 (6.0%)	4 (8.5%)	
Heart failure		4 (3.3%)	5 (4.6%)	7 (14.0%)	8 (17.0%)	0.003*
Cardiogenic shock		2 (1.7%)	2 (1.9%)	5 (10.0%)	5 (10.6%)	0.007*
Major in-hospital adverse Events		NSTE-ACS (n=227)				P
		Group I (n=80)	Group II (n=81)	Group III (n=44)	Group IV (n=22)	
Mortality		3 (3.8%)	5 (6.2%)	5 (11.4%)	3 (13.6%)	0.248
Acute stent thrombosis		2 (2.5%)	1 (1.2%)	1 (2.3%)	0 (0.0%)	0.843
CVS		0 (0.0%)	0 (0.0%)	2 (4.5%)	2 (9.1%)	0.009*
Dissection		7 (8.8%)	8 (9.9%)	6 (13.6%)	4 (18.2%)	0.575
Perforation		2 (2.5%)	3 (3.7%)	5 (11.4%)	3 (13.6%)	0.063
CIN		6 (7.5%)	9 (11.1%)	8 (18.2%)	5 (22.7%)	0.143
limb ischemia		0 (0.0%)	2 (2.5%)	3 (6.8%)	1 (4.5%)	0.140
Hemorrhage	Non major bleeding	9 (11.3%)	11 (13.6%)	9 (20.5%)	6 (27.3%)	0.168
	Major bleeding	2 (2.5%)	3 (3.7%)	4 (9.1%)	2 (9.1%)	
Heart failure		3 (3.8%)	3 (3.7%)	5 (11.4%)	5 (22.7%)	0.007*
Cardiogenic shock		1 (1.3%)	2 (2.5%)	4 (9.1%)	3 (13.6%)	0.025*

*Data are presented as frequency (%), * significant as P value ≤ 0.05. CVS: cerebro-vascular stroke, CIN: Contrast-Induced Nephropathy, PCI: Percutaneous Coronary Intervention, STEMI: ST segment Elevation Myocardial Infarction and NSTEMI: Non-ST segment Elevation Myocardial Infarction, ACS: Acute Coronary Syndrome*

Table 3. Follow-up adverse events after 3 months in elective PCI, STEMI and NSTE-ACS patients' groups

Three month follow up	Elective PCI excluding In-hospital deaths (n=373)				P
	Group I (n=148)	**Group II (n=134)**	**Group III (n=63)**	**Group IV (n=28)**	
Loss of follow up	16 (10.8 %)	5 (3.7 %)	6 (9.5 %)	0 (0.0 %)	0.057
Follow up	132 (89.2 %)	129 (96.3 %)	57 (90.5%)	28 (100.0 %)	
	(n=132)	**(n=129)**	**(n=57)**	**(n=28)**	
Mortality	1 (0.8 %)	3 (2.3 %)	2 (3.5 %)	1 (3.6 %)	0.552
CVS	1 (0.8 %)	0 (0.0 %)	1 (1.8 %)	1 (3.7 %)	0.247
Follow up MI	4 (3.1 %)	3 (2.4 %)	2 (3.6 %)	2 (7.4 %)	0.608
Recurrent PCI	2 (1.5 %)	3 (2.4 %)	2 (3.6 %)	3 (11.1 %)	0.138
Three month follow up	**STEMI**				**P**
	Group I (n=120)	**Group II (n=108)**	**Group III (n=50)**	**Group IV (n=47)**	
Follow up status	**(n=116)**	**(n=101)**	**(n=43)**	**(n=40)**	0.716
Loss of follow up	8 (6.9%)	6 (5.9%)	1 (2.3%)	3 (7.5%)	
Follow up	108 (93.1%)	95 (94.1%)	42 (97.7%)	37 (92.5%)	
Mortality	**(n=108)**	**(n=95)**	**(n=42)**	**(n=37)**	0.233
	2 (1.9%)	3 (3.2%)	3 (7.1%)	3 (8.1%)	
CVS	106 (98.1%)	92 (96.8%)	38 (90.5%)	34 (91.9%)	0.111
Follow up MI	2 (1.9%)	4 (4.2%)	4 (9.5%)	4 (10.8%)	0.076
Recurrent PCI	23 (21.3%)	25 (26.3%)	16 (38.1%)	14 (37.8%)	0.091
Three month follow up	**NSTE-ACS (n=227)**				**P**
	Group VI (control) (n=77)	**Group I (n=79)**	**Group II (n=39)**	**Group III (n=19)**	
Loss of follow up	7 (9.1%)	5 (6.3%)	2 (5.1%)	2 (10.5%)	0.008*
Follow up	70 (90.9%)	74 (93.7%)	37 (94.9%)	17 (89.5%)	
Mortality	**(n=70)**	**(n=74)**	**(n=37)**	**(n=17)**	0.004*
	0 (0.0%)	0 (0.0%)	2 (5.4%)	2 (11.8%)	
CVS	3 (4.3%)	3 (4.1%)	3 (8.1%)	2 (11.8%)	0.524
Follow up MI	1 (1.4%)	3 (4.1%)	2 (5.4%)	2 (11.8%)	0.259
Recurrent PCI	11 (15.7%)	17 (23.0%)	10 (27.0%)	5 (29.4%)	0.138

*Data are presented as frequency (%), * significant as P value ≤ 0.05. CVS: cerebro-vascular stroke, CIN: contrast-induced nephropathy, PCI: Percutaneous coronary intervention, STEMI: ST segment elevation myocardial infarction and NSTEMI: Non-ST segment elevation myocardial infarction, ACS: Acute coronary syndrome, MI: Myocardial infarction*

Only 0.5% of elective PCI population of this study suffered peri-procedural CV stroke, with no cases recorded in the control group <65 years. old. This figure is better than that recorded in Papapostolou et al. [4] study, in which 1% of the study group and 0.2% of control group had CVS. However, in Lian et al. [14] study, CVS figure was lower than this study recording only 0.2% in case group.

In terms with bleeding complication, 11.7% of this study elective PCI population suffered bleeding, with 3.6% suffering major bleeding and the highest figure (23.3%) recorded in group IV (>75 years old). These figures were higher than their counterparts in Papapostolou et al. [4] study in which bleeding complications happened in 3.1% of case group >80 years old.

Regarding contrast-induced nephropathy (CIN), 5.2% of the study elective PCI population developed CIN, with the highest percentage (10%) recorded for group IV (>75 years. Of age) and the lowest in the control group (4%). Those results are comparable to those recorded in Lian et al. [14] study, in which CIN occurred in 6.2% of its population >65 years of age.

Table 4. Multivariate logistic regression for factors affecting mortality among elective PCI patients

	Variables	p	OR	95% C. I
Age	< 65	–	–	-
	65-69	0.035*	1.790	1.168– 6.720
	70-74	0.014*	2.776	1.193 – 6.467
	≥ 75	0.003*	2.992	2.583 – 6.915
Gender	Male®	–	–	-
	Female	0.640	1.303	0.429 – 3.952
Smoking	Ex-smoker	0.849	1.159	0.254 – 5.296
	Current	0.137	2.298	0.778 – 6.987
Family history		0.059	0.324	0.105 – 0.997
DM		0.027*	6.152	1.227 – 30.846
HTN		0.007*	8.152	1.733 – 20.455
Chronic kidney disease	CKD on medical®	–	–	–
	CKD on Dialysis	0.513	0.647	0.176 – 2.385
Dyslipidemia		0.192	0.256	0.033 – 1.983
Obesity		0.603	1.368	0.420 – 4.462
HR (bpm)		0.548	0.533	0.068 – 4.155
Systolic BP (mmHg)		0.985	0.999	0.912 – 1.095
Diastolic BP (mmHg)		0.697	0.807	0.275 – 2.369
Rhythm	SR®	0.304	2.343	0.462 – 11.893
	Other	0.209	2.364	0.617 – 9.059
Access	Radial	–	–	–
	Femoral	0.102	2.548	0.830 – 7.821
	Both	0.368	0.390	0.050 – 3.032
MVD		<0.001*	8.644	2.695 – 27.730
Treated artery	Left main	0.656	0.708	0.155 – 3.228
	LAD	0.068	8.040	0.859 – 75.284
	RCA	0.752	1.137	0.513 – 2.522
	LCX	0.998	0.390	0.050 – 3.032
Stent	BMS	0.759	1.096	0.608 – 1.976
	DES	0.752	1.137	0.513 – 2.522
Number of stents used		0.986	0.937	0813 – 1.922
Largest balloon stent used		0.250	1.108	0.931 – 1.319
Longest stented treated segment		0.548	0.533	0.068 – 4.155
Baseline stenosis	CTO	0.177	4.422	0.510 – 38.315
	Subtotal occlusion	0.949	1.052	0.222 – 4.972
	70 - 80 %	0.187	1.150	0.935 – 1.414
Final stenosis	<60			
	60 – 80	0.187	1.150	0.935 – 1.414
	> 80	0.177	4.422	0.510 – 38.315
Acute stent thrombosis		0.376	4.242	0.610 – 18.551
CVS		0.177	2.522	0.790 – 19.325
Dissection		0.017*	4.097	1.284 – 13.077
Perforation		<0.001*	6.440	4.640 – 36.060
CIN		0.849	1.159	0.254 – 5.296
limb ischemia		0.137	2.298	0.778 – 6.987
Hemorrhage	Non major bleeding	0.759	1.096	0.608 – 1.976
	Major bleeding	0.001*	4.240	2.620 – 6.060
Recurrent PCI		0.250	1.108	0.931 – 1.319
Baseline ECHO		0.759	1.096	0.608 – 1.976
ECHO FU after 3 months		0.752	1.137	0.513 – 2.522

** Significant as P value ≤ 0.05. CVS: cerebro-vascular stroke, CIN: contrast-induced nephropathy, PCI: Percutaneous coronary intervention, DM: Diabetes mellitus, HTN: Hypertenstion, CKD: Chronic kidney disease, HR: Heartrate, SR: Sinus rhythm, BP: Blood pressure, MVD: Multivessel disease, LAD: Left anterior descending artery, RCA: Right coronary artery, LCX: Left circumflex coronary artery, BMS: Bare-metal stent, DES: Drug eluting stent, CTO: Chronic total occlusion, ECHO: Echocardiography*

Table 5. Multivariate logistic regression for factors affecting mortality among ACS patients

	Variables	p	OR	95% C. I
Age groups	< 65®	–	–	-
	65-69	0.007*	2.244	1.734 – 4.898
	70-74	0.002*	4.987	2.738 – 8.355
	≥ 75	0.001*	6.937	2.277 – 10.446
Gender	Male®	–	–	-
	Female	0.440	1.063	0.328 – 4.252
Smoking	Ex-smoker	0.749	1.987	0.154 – 5.196
	Current	0. 379	3.982	0.678 – 5.387
Family history		0.799	0.524	0.105 – 0.797
DM		0.029*	6.112	1.988 – 11.846
HTN		0.005*	7.553	1.789 – 13.415
Chronic kidney disease	CKD on medical®	–	–	–
	CKD on Dialysis	0.017*	3.953	2.953 – 8.945
Dyslipidemia		0.007*	8.152	1.246 – 11.923
Obesity		0.913	1.258	0.214 – 4.192
HR (bpm)		0.548	0.533	0.068 – 3.175
Systolic BP (mmHg)		0.915	0.945	0.712 – 1.095
Diastolic BP (mmHg)		0.627	0.873	0.675 – 2.369
Rhythm	SR®	0.304	1.043	0.762 – 1.893
	Other	0.209	0.364	0.117 – 1.059
Access	Radial®	–	–	–
	Femoral	0.102	2.548	0.913 – 4.821
	Both	0.768	0.540	0.069 – 2.932
MVD		0.001*	5.814	2.215 – 8.211
Treated artery	Left main	0.006*	1.708	1.155 – 3.128
	LAD	0.098	3.142	0.779 – 5.184
	RCA	0.752	1.727	0.913 – 2.729
	LCX	0.998	0.690	0.850 – 3.092
Stent	BMS	0.598	1.889	0.627 – 1.676
	DES	0.526	1.737	0.715 – 2.833
Number of stents used		0.059	1.117	0.513 – 1.229
Largest balloon stent used		0.260	1.008	0.901 – 2.119
Longest stented treated segment		0.748	0.588	0.069 – 2.055
Final TIMI	0	0.003*	2.656	1.259 – 4.208
	I	0.015*	1.908	2.755 – 5.128
	II	0.177	4.422	0.510 – 38.315
Acute stent thrombosis		0.376	4.242	0.610 – 18.551
Cerebrovascular event		0.177	2.522	0.790 – 19.325
Dissection		0.017*	3.697	1.284 – 9.077
Perforation		<0.001*	4.540	3.640 –6.060
CIN		0.849	1.159	0.184 – 4.216
limb ischemia		0.337	1.298	0.978 – 3.987
Hemorrhage	Non major bleeding	0.199	1.996	0.218 – 2.476
	Major bleeding	0.001*	3.240	1.620 – 6.060
Recurrent PCI		0.150	1.456	0.381 – 1.069
Baseline ECHO		0.459	1.036	0.518 – 1.576
ECHO FU after 3 months		0.552	1.011	0.513 – 2.522

** Significant as P value ≤ 0.05. CVS: cerebro-vascular stroke, CIN: contrast-induced nephropathy, PCI: Percutaneous coronary intervention, DM: Diabetes mellitus, HTN: Hypertenstion, CKD: Chronic kidney disease, HR: Heartrate, SR: Sinus rhythm, BP: Blood pressure, MVD: Multivessel disease, LAD: Left anterior descending artery, RCA: Right coronary artery, LCX: Left circumflex coronary artery, BMS: Bare-metal stent, DES: Drug eluting stent, CTO: Chronic total occlusion, ECHO: Echocardiography, TIMI: Thrombolysis in Myocardial Infarction*

Regarding short term follow-up adverse events complicating elective PCI in this study, mortality recorded in 2.0% of all elective patient who were committed to follow-up for 3 months, with the highest level recorded in the oldest group IV (>75 years. old) in which death occurred to 3.6% of

patients and the lowest in the control group <65 years of age which mortality recorded in 0.8%. This percentage is remarkably lower than to mortality level in Papapostolou et al. [4] study which was 6.4% in case group and 2.2% in control group within one month of follow up. This may be explained by the higher age of its population (>80years) [5].

Only 0.9% of elective PCI population of this study suffered CV stroke for three month follow up. This figure is slightly better than that recorded in Papapostolou et al. [4] study, in which 1.3% of the study group and 0.4% of control group suffered CVS.

With regards to follow-up myocardial infarction, 3.6% of the elective PCI population of this study suffered MI, with the highest figure (7.4%) recorded in group IV (>75 years. Of age) and the lowest figure (2.6%) in group II which comprised patients 65 to 69 years old. These results are higher than that figure recorded in Papapostolou et al. [4] study, in which 2.5% of the study group and 1.7% of control group suffered MI. This may be explained by the shorter follow up time in the latter study (only one month versus three months in this study).

In terms with follow-up period recurrent elective PCI, 2.9 % of the elective PCI population of this study needed recurrent elective PCI, with the highest figure (11.1%) recorded in group IV (>75 years. old) and the lowest figure (1.5%) in the control group (<65 years old) which. These results are also higher than the figures recorded in Papapostolou et al. [4] study, in which only 2.0% of the study group and 2.3% of control group suffered recurrent PCI. This also may be explained by the shorter follow up time in the latter study.

Regarding in-hospital outcomes among STEMI patients, 7.7% of STEMI patients suffered in-hospital mortality, with the highest percentage (14.9%) recorded in group IV (>75 years. Of age). These figures are better than those recorded in Nasrin et al. [16] study (16%) done in Bangladesh which is a developing country. On the other hand, our figures were slightly higher than those recorded in the study conducted by Furnaz et al. [17] (6.4%).

In-hospital cerebrovascular stroke (CVS) was noted in 2.5% of STEMI patients, with the highest figure recorded in group III (6.4%). Those figures were better than those noticed in the study fulfilled by Kocayigit et al. [18] in which 8.9% of primary PCI patients suffered ischaemic stroke. However, CVS figure (3.4%) in the study done by Wang et al. [19] may be considered better than its counterpart in our study as its population was very elderly women >80 years of age.

Regarding bleeding complications, 4.3% of the patients in our study suffered major bleeding, with the highest figure (8.5%) recorded in group IV (>75 years old). Those above-mentioned figures were a bit better than those recorded in the study fulfilled by Kocayigit et al. [18] in which 8.9% of primary PCI patients suffered major bleeding. Notably, major bleeding wasn't noted in the population of the study done by Nasrin et al. [16]. This may be explained by the small number of study population (only 46 patients) which gives the chance to miss some outcomes and over-presentation of other outcomes [16].

In terms with heart failure among STEMI patients, 7.4% of study population developed heart failure during in-hospital period. In the study conducted by Nasrin et al. [16], the figure of heart failure was markedly higher recording 17%.

Cardiogenic shock was observed in 4.3% of the STEMI patients of this study, with the highest figure (10.6%) recorded in group III (>75years old). Those figures were evidently higher than all age group in the Japanese large study conducted by Numasawa et al. [20] even in nonagenarians (>90years old) in which cardiogenic shock among ACS patients was recorded in 2.9%. This may be explained by the relative slowness in emergency response to STEMI patients and the consequent delay in door-to-balloon time in Egypt in comparison to a more developed country like Japan [20]. However, it was notable that in another large Japanese study, Uemura et al. [21], cardiogenic shock figures were markedly higher recorded in 8.1% of its elderly STEMI population, with 8.6% figure in its population >75years old.

Regarding hospital stay for STEMI population in the current study, it ranged from one to ten days, with the highest average time (2.2 ±0.9) recorded in group IV (> 75 years old.). Hospital stay was generally shorter than its counterpart in the study done by Nasrin et al. [16] in which average hospital stay was 4.0 ± 1.9, ranging from two to 11 days. The reason behind this may be the lower rate of complications requiring longer hospital stay for our population.

Regarding short term follow-up of patients' outcomes after three months, only 6% of STEMI

patients lost follow-up. In the study fulfilled by Furnaz et al. [17] which comprised elderly STEMI patient >65 years old, the loss of follow up was markedly higher (43.9%). This may be explained by the longest follow-up period ranging from 4 month to 2 years.

Short-term mortality figure in the current study was 3.9%, with the highest percentage (8.1%) recorded in the eldest group IV (>75 years. old). Those figures were markedly lower than the study fulfilled by Kocayigit et al. [18] in which mortality figure was 17.8% of STEMI primary PCI patients. This may be explained in part by the longer follow-up period (6 months). In the large Asian registry conducted by Jin et al. [22] mortality figure in patients >75 years. old was 7.9%, which is similar to the figure of group IV in our study despite the longer follow-up period (12 months).

Recurrent MI occurred among 4.3% of STEMI patients of the current study during short-term follow-up period, with rising figures notes with increasing age, and the highest recorded figure reserved for group III (10.8%). In the study fulfilled by Furnaz et al. [17] re-infarction rate was higher (20.8%), and this is generally expected due to the longer follow-up period.

Regarding in-hospital outcomes among NSTE-ACS patients, 7.0% of NSTE-ACS patients suffered in-hospital mortality, with the highest percentage (13.3%) recorded in group IV (>75 years. old). These figures are better than those recorded in the study performed by Wang et al. [19] in which in-hospital mortality recorded 16.4% in its population of very elderly females >80 years old. Also, in the study conducted by Hirlekar et al. [23] which included >80 years. old elderly patients, in-hospital death rates were relatively high (11.1%) which is comparable to the figure recorded in our group IV of patients (>75 years old). However, in the large Japanese registry study performed by Numasawa et al. [20] in-hospital mortality was recorded in only 5.2% of its ACS population >90 years. old, reflecting the high standard of care for ACS patients in Japan.

In-hospital cerebrovascular stroke (CVS) was recorded in only 1.8% of NSTE-ACS patients, all of them in group III and IV (>70 years old). Those figures were better than those noticed in the study performed by Wang et al. [19] in which in-hospital peri-procedural CVS recorded 3.4% in its population of very elderly females >80 years old.

Regarding bleeding complications, 4.8% of the NSTE-ACS patients in the current study suffered major bleeding, with the highest figure (9.1%) recorded in group IV (>75 years old). Those above-mentioned figures were markedly higher than the Japanese study done by Numasawa et al. [20] in which only 1.2% of its ACS population >90 years. old suffered major bleeding.

Cardiogenic shock occurred among 4.4% of the NSTE-ACS population in the current study, with the highest figure (13.6%) recorded in group IV (>75years old). Those figures were evidently higher than all age group in the Japanese large study conducted by Numasawa et al. [20] even in nonagenarians (>90years old) in which cardiogenic shock among ACS patients was recorded in only 2.9%. This may be explained by the discrepancy between the chronological age and the actual age among Egyptian patients struck by multiple co-morbidities and facing the relatively limited resources and poorer health awareness in comparison to their Japanese counterparts.

Regarding hospital stay for NSTE-ACS population in the current study, it ranged from one to eight days, with the highest average time (2.1 ± 0.6 days) recorded in group IV (> 75 years. old.). It is noted that hospital stay figures were markedly shorter than the study conducted by Wang et al. [19] in which hospital stay ranged from six to ten days, with 7 days in average. This may be explained by the lower frequency of in-hospital complications recorded in the current study, and the relative shortage of CCU beds indicating a more rapid cycle of admission and discharge of patients.

In terms with heart failure among NSTE-ACS, it was recorded in 7% of our population, with the highest figure reserved as usual for group IV (22.7%). Those figures were higher than those recorded in the study done by Wang et al. [19] in which heart failure were faces in 9.1% of ACS patients >80 years old.

Regarding short term follow-up of patients' outcomes after three months, only 7.5% of NSTE-ACS patients lost follow-up. Short-term mortality figure in the current study was only 2%, with the highest percentage (11.8%) recorded in the eldest group IV (>75 years. old). This result was statistically significant (P value =0.004) reflecting the profound relationship between increasing age and poorer PCI outcomes. In the

study fulfilled by Hirlekar et al. [23] follow-up mortality was 11%. However, this may be explained by the longer follow-up period (12 months). In the study conducted by de Belder et al. [24] the follow up mortality was 18.5% in the invasive strategy arm among elderly patients >80 years of age. This relatively high figure is expected as the age cut point is higher than that in the current study and of course due to the longer follow-up period (12 months).

Recurrent MI occurred in 4.0% of NSTE-ACS patients of the current study during the three-month short-term follow-up period, with the highest figure as expected for group III (11.8%). In the study fulfilled by Hirlekar et al. [23] follow-up recurrent MI was 12.9 % in the invasive strategy arm. This relatively high figure may be referred to the longer 12-months follow up beside the higher age among the participants.

CVS occurred in 5.5% of the NSTE-ACS population of the current study during the three-month follow-up period, with the highest percentage (11.8%) recorded in group IV. this figure was higher than that recorded in the study conducted by Hirlekar et al. [23] which was only 3.7% despite the higher age among its >80 years population.

5. CONCLUSIONS

Elderly Egyptian people aged more than 65 years old are considered vulnerable to complications and less perfect outcomes of coronary intervention, particularly in the setting of ACS and complex coronary anatomy. On the other hand, the era of newer generations of drug-eluting stents and wide-availability of the safer radial artery access mitigated the risks of PCI related major adverse cardiovascular events and improved the long-term clinical outcomes in elderly patients suffering from both high-risk chronic and ACSs, in particular, those patients presenting with STEMI and NSTEMI.

CONSENT AND ETHICAL APPROVAL

An informed written consent was obtained from the patients. The study was done after approval from the Ethical Committee of Tanta University Hospitals.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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