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Original Article

Success Rate, Procedural Complications and Clinical Outcomes of Coronary Interventions in Octogenarians: a Case-Control Study

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Abstract

Background: *Clinical trials of revascularization have routinely under-enrolled elderly subjects. Thus, symptom relief and improved survival might not apply to elderly patients, in whom the risk of mortality and disability from revascularization procedures seems to be high and co-morbidity is more prevalent. The present case control study was performed to draw a comparison in terms of the procedural success, procedural and in-hospital complications, and major adverse cardiac events (MACE) in a one-year follow-up of octogenarians (age ≥ 80 years) with a selected matched younger control group in the Tehran Heart Center Angioplasty Registry.*

Methods: *According to the Tehran Heart Center Interventional Registry of 9, 250 patients with a minimum follow-up period of one year between April 1993 and February 2010, 157 percutaneous coronary intervention (PCI) procedures were performed in 112 octogenarians. Additionally, 336 younger patients (459 PCI procedures) were selected from the database as the propensity-score matched controls.*

Results: *There were 147 (93.6%) and 441 (96.1%) successful PCI procedures in the elderly group and control group, respectively (p value = 0.204). Procedural complications were seen in 5 (3.2%) of the elderly group and 16 (3.5%) of the control group (p value = 0.858). Totally, 7 (6.3%) in-hospital complications occurred in the elderly group and 22 (6.8%) in the control group (p value = 0.866). One-year MACE was seen in 9 (9.1%) of the elderly and 18 (5.8%) of the control group (p value = 0.26).*

Conclusion: *Procedural success and complications, in-hospital complications, and one-year MACE were not significantly different between our two study groups. Therefore, age alone should not be used as the sole criterion when considering revascularization procedures. Furthermore, PCI should not be refused in octogenarians if indicated.*

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Introduction

Clinicians often divide older patients into two subgroups - those 65 to 80 years of age and the ones older than 80 years - to highlight frailty, reduced capacity (physical and mental), and presence of co-morbidities, which are more common in octogenarians.[1] Cardiovascular disease is the most frequent diagnosis in elderly people,[1] and both the prevalence[1] and severity of atherosclerotic coronary artery disease (CAD) increase with age in men and women.[1, 2]

For patients with symptomatic chronic CAD, revascularization therapy provides symptom relief and may even confer improved survival in certain high-risk patients.[3-5] However, on account of the fact that these findings are based on middle-aged populations and clinical trials of revascularization have routinely under-enrolled elderly subjects,[6] the results may not be applicable to elderly patients, in whom the risk of mortality and disability from revascularization procedures seems to be high[1, 7, 8] and co-morbidity is more prevalent.[7-9]

Six percutaneous coronary intervention (PCI) registries (n = 48,439) and 8 coronary artery bypass grafting surgery (CABG) registries (n = 180,709) voluntarily contributed all their procedural data on patients aged ≥ 75 years from 1990 through 1999: Pooled estimates of in-hospital mortality following PCI during this decade was 3.0% (range = 1.5% - 5.2% among databases), mortality rates declined significantly in older patients for both PCI and CABG over this decade, and outcomes improved.[6]

The TIME trial enrolled 150 patients aged 75 years or older for medical therapy and 155 for invasive therapy. This trial showed that elderly patients with angina, despite standard drug therapy, benefited more from revascularization than from optimized medical therapy in terms of symptom relief and quality of life.[10] In this trial, non-fatal events occurred more frequently in patients assigned to medical treatment (39% versus 20%, p value < 0.0001)[11] and early increased costs of revascularization (PCI or CABG) in invasive patients were balanced after one year by increased practitioners' charges and symptom-driven late revascularizations in medical patients.[12]

The Northern New England Cardiovascular Disease Study Group looked into non-randomized data on 1,700 octogenarians treated for two- or three-vessel disease (excluding left main) and reported better in-hospital mortality and short-term survival for PCI versus CABG.[13] When an old patient needs myocardial revascularization, some authors suggest that the percutaneous approach be considered the treatment of choice in subjects either with stable or unstable angina and in those with acute myocardial infarction (MI).[14] Also, primary angioplasty not only appears to be a very promising strategy in old patients with acute MI[14] but also in octogenarians' outcomes compares favorably with that reported previously for both thrombolytic and medical therapy.[15]

The present case control study was conducted to draw a comparison in terms of procedural success, procedural and in-hospital complications, and major adverse cardiac events (MACE) in a one-year follow-up of octogenarians and a selected matched younger control group in the Tehran Heart Center Angioplasty Registry.

Methods

The Tehran Heart Center Angioplasty Registry included 9,250 patients with a history of PCI with at least a one-year follow-up from April 1993 to February 2010. There were 112 (1.21%) octogenarians (elderly group, age ≥ 80 years, mean age = 81.99 ± 2.33 years) in the registry database, and 336 younger patients (age < 80 years, mean age = 62.36 ± 10.07 years) were selected from the database as controls. The control patients were matched with respect to sex, history of diabetes mellitus, cigarette smoking, hypertension, number of diseased vessel in angiography (one-, two-, or three-vessel disease), ejection fraction, and American College of Cardiology/American Heart Association.(ACC/AHA) type lesions (A, B1, B2, or C) using the propensity-score matching technique.

Procedural success was defined as < 30% stenosis remaining after PCI. If 30-50% stenosis remained, it was defined as acceptable result and if > 50% stenosis remained it was defined as unsuccessful procedure. Diabetes mellitus was defined as fasting blood sugar > 126 mg/dl or a clear history of diabetes treated with diabetes medications. Hypertension was defined as blood pressure > 140/90 mmHg or history of known hypertension with previous drug therapy. Cigarette smokers were those who smoked at least once a month and at least one month before the procedure.

Primary PCI procedures were coronary interventions for the treatment of acute ST elevation MI performed in an emergency setting. Ad hoc PCI was defined as PCI that was not planed but was performed at the time of angiography. Classification of the lesions was done via the ACC/AHA classifications[16] of the severity of lesions: type A, type B, and type C. Type A lesions were discrete (< 10 mm), concentric, readily accessible, non-angulated segment (< 45 degrees), smooth contour, little or no calcium, less than totally occlusive, not ostial in locations, no major side branch involvement, and absence of thrombus.[16] Type B was defined if one of the following was present: tubular (10 to 20 mm length), eccentric, moderate tortuosity of proximal segment, moderately angulated segment (≥ 45 degrees, < 90 degrees), irregular contour, moderate to heavy calcification, total occlusions < 3 months old, ostial in location, bifurcation lesion requiring double guide wire, and presence of some thrombus.[16] Type C lesions were lesions with at least one of the following characteristics: diffuse (> 2 cm length), excessive tortuosity of proximal segment, extremely angulated segments, (≥ 90 degrees), total occlusion > 3 months old, inability to protect major side branches, and degenerated vein grafts with friable lesions.[16]

In ostial lesions, the origin of the lesion was within 3 mm of the target vessel origin. Diffuse lesions were defined as lesions > 20 mm in length, calcified as readily apparent densities noted within the apparent vascular wall at the site of the stenosis, bifurcation stenosis as stenosis involving the parent and daughter branches if a medium or large branch (> 1.5 mm) originated within the stenosis and if the side branch was completely surrounded by the stenotic portions of the lesion to be dilated, eccentric as stenosis that was noted to have one of its luminal edges in the outer one quarter of the apparent normal lumen, severe proximal tortuosity if the lesion was distal to three bends > 75 degrees, severely angulated if the vessel angle formed by the center line through the lumen proximal and distal to the stenosis, was ≥ 90 degrees, thrombus if discrete, intra-luminal filling defect was noted with defined borders and was largely separated from the adjacent wall, total occlusion if there was no contrast flow through the stenosis (TIMI 0) or a small amount of contrast material flowed through the stenosis but failed to opacify fully the epicardial vessel (TIMI 1), degenerated saphenus vein graft as graft characterized by luminal irregularities or ectasia constituting > 50% of the graft length,[17] and restenosis as PCI performed for a target lesion that had been treated previously with PCI.

Lesion length was measured "shoulder to shoulder" in an un-foreshortened view,[17] and the severity of stenosis was estimated by the experienced operator and stent diameter was assumed as reference vessel diameter.

Procedural complications included one of the following: 1. Elastic recoil, 2. Abrupt closure, 3. Side branch loss, 4. Dissection, 5. Coronary perforation, and 6. Abnormal slow flow.

Abrupt closure was defined as the obstruction of the contrast flow (TIMI 0 or 1) in a dilated segment with previously documented anterograde flow,[17] dissection as the persistence of the contrast within the dissection after the washout of the contrast material from the remaining portion of the vessel, coronary perforation as the extravasations of the contrast material confined to the pericardial space immediately surrounding the artery or not localized to the pericardial space, distal embolization as the migration of a filling defect or thrombus to distally occlude the target vessel or one of its branches and coronary spasm as transient or permanent narrowing > 50% when a < 25% stenosis had been previously noted,[17] side branch loss as TIMI 0 flow in a side branch > 1.5 mm in diameter that previously had TIMI 3 flow, and abnormal slow flow as TIMI 2 flow.

Dissection was classified as type "A" if a small radiolucent area was seen within the lumen of the vessel, "B" if linear, non-persisting extravasations of the contrast material was seen, "C" if extra luminal, persisting extravasations of the contrast material was seen, "D" if a spiral-shaped filling defect was seen, "E" if there was a persistent lumen defect with a delayed anterograde flow, and "F" if the filling defect was accompanied by total coronary occlusion.[17]

In-hospital complications were obtained from the registry database and comprised: 1. post-procedural MI (MI after PCI) was defined as > 3 times rise in creatine phosphokinase MB isoenzyme (CKMB); 2. Pulmonary edema or decompensation of heart failure; 3. Cerebrovascular accident (CVA); 4. Need for urgent cardiac surgery; 5. Need for urgent vascular surgery; 6. Tamponade; 7. Severe hypotension; 8. Significant ventricular arrhythmia during PCI; 9. Cardiopulmonary arrest during PCI; and 10. Death.

MACE included 1 of the following in the one-year follow-up: 1. MI, 2. Death, 3. Need for target lesion revascularization (TLR) with CABG, PCI with bare metal or drug-eluting stenting or percutaneous only balloon angioplasty (POBA), and 4. Need for target vessel revascularization (TVR).

The numerical variables are presented as mean ± SD (standard deviation), and the categorical variables are summarized by raw numbers and percentages. The continuous variables were compared using the student t-test or non-parametric Mann-Whitney U test whenever the data did not appear to have normal distribution, and the categorical variables were compared using the chi-square or Fisher exact test, as required.

Using nearest available Mahalanobis metric matching within calipers defined by the propensity score, each octogenarian patient (age ≥ 80 years) was paired with a younger patient (age < 80 years) whose logit of the propensity score was closest.[18] The patients were matched in terms of sex, history of diabetes mellitus, cigarette smoking, hypertension, number of diseased vessel in angiography (one-, two-, or three-vessel disease), ejection fraction, and ACC/AHA type lesions (A, B1, B2, or C).

For the statistical analysis, the statistical software SPSS version 13.0 for Windows (SPSS Inc., Chicago, IL) and the statistical package SAS version 9.1 for Windows (SAS Institute Inc., Cary, NC, USA) and the free software of R version 2.7.1 were used. All the p values were two-tailed, with statistical significance defined by p value ≤ 0.05.

Results

The baseline characteristics of the two groups (112 octogenarians and 336 control patients) are shown in Table 1. Table 2 presents the results, type of lesions, and immediate complications of PCI. Totally, there were 616 PCI procedures (157 PCI procedures in the elderly group and 459 PCI procedures in the control group). For these procedures, 566 stents (91.9% of the procedures) were used (90.4% of the procedures in the elderly group and 92.4% in the control group, p value = 0.445). Drug-eluting stents were utilized in 43.3% of the stenting procedures (35.9% of the stenting procedures in the elderly group and 46.7% in the control group were drug eluting, p value = 0.041).

PCI for two vessels, three vessels, and four vessels was performed in 19 (17%), 8 (7.1%), and 3 (2.7%) of the elderly group and 77 (22.9%), 14 (4.2%), and 6 (1.8%) of the control group, respectively. There were 5 (3.2%) and 11 (2.4%) unsuccessful PCI procedures in the elderly group and the control group, respectively (p value = 0.569, Table 2). There was a significant relationship between AHA type C and AHA type B2 or type C lesions and unsuccessful procedures (p value < 0.05), but sex, body mass index, history of cigarette smoking, hypertension, diabetes mellitus, hyperlipidemia, number of PCI procedures in a patient, serum triglyceride, low-density lipoprotein (LDL), high-density lipoprotein (HDL) cholesterol, fasting blood sugar, creatinine, and ejection fraction did not show a significant effect on the procedural success of PCI.

Procedural complications were seen in 21 (3.41%) of the procedures; of these 5 (3.2%) happened in the elderly group and 16 (3.5%) in the control group (p value = 0.858, Table 2). Elastic recoil, abrupt closure, side branch occlusion, dissection, coronary artery perforation, and abnormal slow flow were not significantly different between the two groups (Table 2). Cigarette smoking, PCI for four vessels in a patient, fasting blood sugar, serum creatinine, and HDL cholesterol were related to the complications (p value < 0.05). Also, complications tended to occur more frequently in AHA type B2 and C lesions (p value = 0.06) and in patients with higher LDL cholesterol levels (p value = 0.09).

The in-hospital clinical complications and the results of the one-year follow-up of the two groups are depicted in Table 3. The in-hospital clinical complications were seen in 29 (6.47%) patients. Totally, 7 (6.3%) in-hospital complications occurred in the elderly group and 22 (6.8%) occurred in the control group (p value = 0.866). MI was seen in 5 (4.5%) of the elderly group and 21 (6.5%) of the control group (p value = 0.464). There were 2 (1.3%) cases of in-hospital mortality in the elderly group and no mortality in the control group (p value = 0.065, Table 3). Tamponade, severe hypotension, significant ventricular arrhythmia, and cardiopulmonary arrest during PCI were not significantly different between the two groups, and there were no pulmonary edema, decompensation of heart failure, cerebrovascular accident, and need for urgent vascular or cardiac surgery in both groups (Table 3).

The results of the one-year follow-up are depicted in Table 3. MACE was seen in 9 (9.1%) of the elderly group and 18 (5.8%) of the control group (p value = 0.26). Cardiovascular death was seen in 7 (7.1%) patients in the elderly group and in 5 (1.6%) patients in the control group (p value = 0.011, Table 3).

Discussion

The Melbourne Interventional Group Registry of 4,360 PCI procedures included 11.3% of the PCI procedures performed in octogenarians[9] and the National Cardiovascular Network Collaboration study included 7.3% of octogenarian patients.[19] In our study, the prevalence of octogenarians in the registry was only about 1.2%. This may be because the interventional cardiologists in our center have under-enrolled octogenarian patients in contrast to the mentioned registries or because our patient population is younger, which calls for more epidemiological studies for further clarification.

Physicians are usually concerned about procedural

Table 1. Baseline characteristics of elderly group (age ≥ 80 years) and control group (age < 80 years)*

	Elderly group (age ≥ 80 years, n=112)	Control group (age < 80 years, n=336)	p value
Male	90 (80.4)	268 (79.8)	0.892
Creatinine (mg/dl)	1.27±0.32	1.18±0.36	0.012
Triglyceride (mg/dl)	133.2±68.8	178±106.2	< 0.001
LDL Cholesterol (mg/dl)	101.9±36.9	97.5 ±39.3	0.330
HDL Cholesterol (mg/dl)	43.8±12.38	40.47±9.79	0.006
FBS (mg/dl)	107.1±32.6	114.9±47.5	0.070
Previous PCI	5 (4.5)	32 (9.5)	0.092
Previous CABG	2 (1.8)	22 (6.5)	0.054
Ejection fraction (%)	49.92±11.37	50.31±10.77	0.751
Pre PCI stenosis	90.84±7.02	89.65±8.29	0.176
Multi-vessel PCI	30 (21.1)	97 (22.4)	0.751
Primary PCI	7 (6.2)	11 (3.3)	0.171
Ad hoc PCI	14 (12.5)	30 (8.9)	0.271

*Data are presented as mean±SD or n (%)
LDL, Low density lipoprotein; HDL, High density lipoprotein; FBS, Fasting blood sugar; CABG, Coronary artery bypass grafting surgery; PCI, Percutaneous coronary intervention

Table 2. Frequency of coronary interventions in various vessels, AHA type of lesions, results and procedural complications in the case and control groups*

	PCIs for elderly group (age ≥ 80 years, n=157)	PCIs for control group (age < 80 years, n=459)	p value
Target vessel			
LAD or diagonal**	86 (58.5)	225 (54.3)	0.384
LCX, OM or Ramus intermedius	17 (11.6)	65 (15.7)	0.223
RCA, PDA or PLV***	44 (29.9)	112 (27.1)	0.503
LIMA on LAD	0	2 (0.5)	0.999
Saphenus vain grafts	0	10 (2.4)	0.069
AHA type of Lesions			
A	1 (0.7)	32 (7.1)	0.003
B1	29 (19.7)	82 (18.1)	0.659
B2	30 (19.1)	89 (19.4)	0.938
C	87 (59.2)	250 (55.2)	0.396
C or B2	117 (79.6)	339 (74.8)	0.241
Ostial lesions	12 (7.6)	24 (5.2)	0.226
Proximal lesions	76 (48.4)	223 (48.8)	0.933
Diffuse lesions (> 20 mm)	80 (51)	213 (46.4)	0.324
Calcified lesions	8 (5.1)	10 (2.2)	0.094
Bifurcation lesions	15 (9.6)	28 (6.1)	0.143
Eccentric lesions	41 (26.1)	147 (32)	0.165
Severe proximal segment tortous lesions	12 (7.6)	29 (6.3)	0.565
Angulated segment > 90º	3 (1.9)	9 (2.1)	0.999
Thrombotic lesion (first vessel PCI)	7 (4.5)	14 (3.1)	0.401
Total occlusion	30 (6.5)	7 (4.5)	0.344
Stent restenosis	4 (2.5)	7 (1.5)	0.484
Overlapping stent in first vessel	11 (7)	42 (9.2)	0.408
Stent charactristics			
Reference vessel diameter (mm)	3.19±0.43	3.15±0.45	0.471
Lesion length (mm)	22.79±9.62	22.13±11.41	0.569
Stent used	142 (90.4)	424 (92.4)	0.445
Drug-eluting stents used	51 (36.7)	194 (46.7)	0.039
Stent diameter (mm)	3.15±0.38	3.10±0.41	0.343
Stent length (mm)	23.14±6.75	23.06±7.63	0.913
Results			
Unsuccessful	5 (3.2)	11 (2.4)	0.569
Successful	147 (93.6)	441 (96.1)	0.204
Successful and acceptable	152 (96.8)	448 (97.6)	0.569
Procedural complications	5 (3.2)	16 (3.5)	0.858
Elastic recoil	2 (1.3)	4 (0.9)	0.648
Abrupt closure	1 (0.6)	1 (0.2)	0.445
Side branch occlusion	4 (2.5)	5 (1.1)	0.243
Dissection****	1 (0.6)	8 (1.7)	0.460
Coronary artery perforation	0	0	0.999
Abnormal slow flow	3 (1.9)	3 (0.7)	0.176

*Data are presented as mean±SD or n (%)
**One PCI procedure in the elderly group and 6 PCI procedures in the control group were performed for the diagonal artery
***There were 3 PCI procedures for PDA in the elderly group, 2 PCI procedures in the control group, and 2 PLV, which were performed in the control group
****Dissection in the elderly group was type B. In the control group, there were 2 type A, 2 type B, 3 type C, and 1 type E dissections
AHA, American Heart Association; LAD, Left anterior descending; LCX, Left circumflex artery; RCA, Right coronary artery; OM, Obtus marginalis; LIMA, Left internal mammary artery; PCI, Percutaneous coronary intervention; PDA, Posterior descending artery; PLV Posterior left ventricular branch

success, complications, disability, and mortality from revascularization procedures in elderly patients, especially octogenarians. Thus, many interventional cardiologists have under-enrolled elderly patients for invasive procedures. However, the elderly have the potential to gain the most clinical benefit from an early invasive approach (compared with conservative management) because of their higher baseline risk.[9] Meanwhile, according to the TIME trial, elderly patients with medical treatment failure benefit more from revascularization in terms of symptom relief and quality of life.[10]

Table 3. In-hospital clinical complications and results of one-year follow up in elderly and control groups*

	Elderly group (age ≥ 80 years, n=112)	Control group (age <80 years, n=336)	p value
In-hospital clinical complications	7 (6.3)	22 (6.8)	0.866
In-hospital myocardial infarction	5 (4.5)	21 (6.5)	0.464
Pulmonary edema or decompensation of heart failure	0	0	-
In-hospital cerebrovascular accident	0	0	-
Need for urgent cardiac surgery	0	0	-
Need for urgent vascular surgery	0	0	-
Tamponade	1 (0.6)	0	0.255
Severe hypotension	1 (0.6)	0	0.255
Significant ventricular arrhythmia during PCI	0	1 (0.2)	0.999
Cardiopulmonary arrest during PCI	1 (0.6)	0	0.255
In-hospital death	2 (1.3)	0	0.065
Results of one-year follow-up**			
MACE	9 (9.1)	18 (5.8)	0.255
TVR	2 (2)	8 (2.6)	0.999
TLR	2 (2)	3 (1)	0.599
Non-fatal MI	4 (4)	7 (2.3)	0.474
Cardiovascular death	7 (7.1)	5 (1.6)	0.011
Total mortality	8 (8.1)	6 (1.9)	0.007

*Data are presented as n (%)
**There were missing data on 40 cases in the one-year follow-up: 13 in the elderly group and 27 in the control group
PCI, Percutaneous coronary intervention; MACE, Major adverse cardiac event; TVR, Target vessel revascularization; TLR, Target lesion revascularization; MI, Myocardial infarction

Voudris et al. observed that in their 69 elderly (age > 70 years) patients, the clinical success rate of coronary stenting was not different from that of 333 younger patients.[20] Chen and associates found that in 201 cases with PCI, the immediate success rate of PCI was 99.01% (199/201), and no significant difference was found in the three age groups (< 60-year-old group, 60- to 74-year-old group, and 75- to 89-year-old group).[2]

In our study, AHA type C lesion was a powerful predictor of unsuccessful PCI and the elderly group was not a predictor. Meanwhile, the procedural success rate in the octogenarians was not significantly different from that of the matched controls, who had the same complexity of lesions (93.6% in the elderly group and 96.1% in the control group, Table 2). It seems that PCI could be achieved with an acceptable procedural success in octogenarians if needed.

The National Cardiovascular Network Collaboration in a multicenter study compared the clinical characteristics and in-hospital outcomes of 7,472 octogenarians with those of 102,236 younger patients. In that study, the octogenarians had more co-morbidities, more extensive coronary disease, and a two- to four-fold increased risk of complications including death (3.8% vs. 1.1%), Q-wave MI (1.9% vs. 1.3%), stroke (0.58% vs. 0.23%), renal failure (3.2% vs. 1.0%), and vascular complications (6.7% vs. 3.3%) (p value < 0.001 for all comparisons).[19] Age > 85 years was one of the independent predictors of procedural mortality in the octogenarians (OR = 2.1, 95%CI: 1.5 to 2.7). For elective procedures, octogenarian mortality varied nearly ten-fold and was strongly influenced by co-morbidities (0.79% mortality with no risk factors vs. 7.2% with renal insufficiency or left ventricular ejection fraction < 35%). PCI outcomes in the octogenarians improved significantly over four years of observation (OR = 0.61 for death/MI/stroke in 1997 vs. 1994; 95%CI: 0.45 to 0.85).[19]

Little et al. retrospectively compared the results of PTCA in 118 octogenarians to that of 500 younger subjects. Major complication rates were 5.9% for the elderly and 3.8% for the younger patients (p value < 0.008) and hospital mortality was higher amongst the octogenarians (4.6% vs. 0.2%, p value < 0.05).[21] Voudris et al. studied 402 consecutive patients with CAD who underwent coronary artery stenting. Of these, 69 were elderly (age > 70 years). No difference in terms of in-hospital complications was seen.[20]

Chen et al. found that the incidence of two-vessel disease, multi-vessel disease, and complex lesions in the old group (60- to 74-year-old group, 92 cases) and very old group (75- to 89-year-old group, 76 cases) was more frequent than that in the younger group (< 60-year-old group, 33 cases) (p value < 0.05). The Gensini score increased significantly from the younger group to the very old group (40.50 vs. 42.00 vs. 45.25, p value < 0.05, p value < 0.01, p value < 0.01). The complete revascularization in the very old group was much less than that in the old and younger groups. Logistic regression analysis showed that only the incomplete revascularization was the independent risk factor of adverse events.[2] Registry data suggest in-hospital mortality risk of PCI < 1% in patients younger than 60 years of age, which increases to about 4% in patients older than 75 years and is greater than 5% in patients older than 80 years of age.[22,-23]

In our study, the in-hospital clinical complications were not significantly different between the two groups (6.3% of the elderly group and 6.8% of the control group, Table 3). The in-hospital mortality tended to be higher in the elderly group (p value = 0.065, Table 3), but the in-hospital MI, tamponade, severe hypotension, significant ventricular arrhythmia, and cardiopulmonary arrest during PCI were not significantly different between the two groups and there were no pulmonary edema or decompensation of heart failure, cerebrovascular accident, and need for urgent vascular or cardiac surgery in both groups (Table 3).

This observation in our study may be in consequence of matching risk factors and lesion severity. The incidence of two- and three-vessel disease was matched in our study and as Chen et al.[2] stated, incomplete revascularization is the independent risk factor of adverse events. However, our study group had a limited sample size and our study was not sufficiently powered to draw a definite comparison of possible influencing factors on in-hospital complications.

We found no significant difference in regard to the total procedural complications in the elderly group and the matched control group (3.2% of the procedures in the elderly and 3.5% in the control group, p value = 0.858, Table 2). Elastic recoil, abrupt closure, side branch occlusion, dissection, coronary artery perforation, and abnormal slow flow were not significantly different between our two study groups (Table 2).

During the pre-stent era, a procedural mortality risk five-fold higher in patients > 80 years compared with those < 60 years has been previously reported.[14] Routine stenting has improved procedural outcomes and reduced complications,[14, 24-26] procedural mortality, acute MI, and emergency CABG. Indeed, these reductions have also been observed in the elderly.[14] In our study, the majority of the interventions were carried out using stents (90.4% of the procedures in the elderly group and 92.4% of the procedures in the control group p value = 0.445, Table 2). Consequently, a lower complication rate is anticipated in our patient group. Also, matching the severity of the lesions is likely to be the reason for the near equal procedural complications. Nonetheless, the very low rate of the procedural complications in our patient group confirms the notion that interventional cardiologists should not be afraid of procedural complications in octogenarians.

In the Melbourne Interventional Group Registry, octogenarians (compared with patients < 80 years of age) were more likely to be female and have greater co-morbidities. In addition, the octogenarians more frequently presented with acute coronary syndromes and cardiogenic shock.[9] In our study, primary PCI and ad hoc PCI tended to be higher amongst the octogenarians (Table 1), but this was not significant. The Melbourne Registry octogenarian patients had significantly increased thirty-day (6.0 vs. 1.4%, p value < 0.01) and twelve-month mortality (8.4% vs. 2.5%, p value < 0.01), and MACE rates at thirty days (11.3% vs. 5.4%, p value < 0.01) and twelve months (18.7% vs. 12.9%, p value = 0.04). Cardiogenic shock, ST-segment elevation MI, chronic renal failure, and age ≥ 80 years were the independent predictors of twelve-month mortality.[9]

Voudris and co-workers showed that at two years, event-free survival was 62% in the elderly and 76% in younger patients (p value < 0.001); this difference was mostly made-up by the recurrence of angina in the elderly.[20]

Although MACE tended to be lower in the octogenarians of our study (9.1% vs. 5.8%, p value = 0.26, Table 3) and TVR, TLR, and non-fatal MI were not significantly different between the two groups, cardiovascular death and total one-year mortality were seen significantly more in these groups (Table 3). The increased one-year cardiovascular death and total mortality in the octogenarians might be due to increased co-morbidities in this age group. It is worthy of note, however, that our population of octogenarians was limited and more patients are needed to show the predictors of mortality and MACE.

Drug-eluting stents have shown further reduction in repeat revascularization in selected populations and lesion subgroups. However, there is currently a paucity of data pertaining to octogenarians undergoing PCI in the contemporary era of drug-eluting stents.[24-26] In our study, although 39.77% of the stents used for PCI were drug-eluting stents (36.7% of the stents in the elderly group and 46.7% of the procedures in the control group), they were employed less frequently in the elderly group (p value = 0.039, Table 2); this may be because our clinicians believe that life expectancy is lower among octogenarians and thereby they use fewer drug-eluting stents in this age group. On the other hand, clinicians are concerned about bleeding complications in the elderly and, as a result, prefer to use fewer drug-eluting stents to avoid bleeding complications of dual antiplatelet therapy.

There is no doubt that more studies are required to investigate whether the use of more drug-eluting stents in the elderly may confer better long-term results.

Conclusion

Procedural success, procedural complications, in-hospital complications and one-year MACE were not significantly different between the octogenarians and the control group of our study; however, one-year cardiovascular mortality was seen more in the octogenarians. Thus, considering the ACC/AHA CABG and PCI guidelines, age alone should not be used as the sole criterion when opting for revascularization procedures. We would suggest that early invasive approach and PCI for symptom relief in case of medical treatment failure not be refused in octogenarians if indicated.

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