PRIMARY PERCUTANEOUS CORONARY INTERVENTION IN PATIENTS AGED OVER 75 YEARS OLD

Nguyen Do Anh[1]

ABSTRACT

Background: *There is remarkable difference in primary percutaneous coronary intervention (P.PCI) in the elderly and younger patients, in terms of clinical characteristics and treatment efficacy. In Vietnam, there have been only few studies about P.PCIin the elderlywith ST segment elevation myocardial infarction (STEMI).*

Method: *Retrospective, descriptive cross-sectional study.*

Results: *There were 225 STEMI patients aged ≥ 75 years old: higher proportion of females (55.6%), higher percentages of patients with intermediate and high TIMI scores (40% and 33.3%), cardiogenic shock before P.PCI (14.2%), and concomitant left main disease (6.2%). The study also illustrated higher rate of TIMI 0-1 flow before P.PCI (70.7%), multi-vessel disease (mean 2.1 ± 0.05), and higher percentage of patients with inappropriate coronary anatomy for P.PCI (3.1%) in the elderly. In-hospital mortality was also higher in patients aged ≥ 75 years old compared to younger patients (15.6% and 6.2%, respectively; p < 0.001; OR 2.51; CI 95%: 1.44 - 4.38). In-hospital mortality after P.PCI in STEMI patients with cardiogenic shock aged ≥ 75 and 60-74 were 42.9% and 40.7%, respectively; p=0.88; OR: 0.95; CI 95%: 0.49-1.86).*

Conclusion: *In elderly patients presenting with STEMI, including those suffering cardiogenic shock, P.PCI is the first-line therapy because of its efficacy regardless of age.*

I. BACKGROUND

STEMI in elderly patients usually has more severe manifestations and higher mortality rate compared to younger patients. *Vital Heart Response* registry showed that the percentage of STEMI patients aged ≥ 75 with Killip class III and IV is statistically significantly higher than that of those aged <75 (Killip class III: 1.3% vs. 0.1%; class IV: 8.5% vs. 5.1%; p < 0,001) [20]. Old age is the independent prognostic factor of high mortality in STEMI patients, with in-hospital mortality (of studies) between 10 – 13% [7], [6], [9], [14], [10], [20]. Elderly patients are frequently associated with severe comorbidities, untypical clinical manifestation, equivocal laboratory results, inadequate access to medical health care. Therefore, these patients frequently experience late hospital admission, delayed or missed diagnosis, hence miss the golden hour that P.PCI can be performed effectively [4], [5], [11], [12]. Another important difficulty preventing patients from P.PCI opportunity is patient's families, who are afraid their old age and weak tolerance (cannot to bear) invasive therapies, which may lead to increased risks of mortality and procedural complications [19]. Cardiologists are even less likely to choose

1. Department of Interventional Cardiology, Gia Dinh People's hospital

Corresponding author: Nguyen Do Anh
Email: nguyendoanh051@gmail.com ; Tel: 0916924051
Received: 25/4/2017; **Revised:** 27/5/2017;
Accepted: 19/6/2017

primary coronary revascularization in the elderly than younger patients. Even when old patients undergo invasive therapies, coronary lesions are usually complicated, which decrease the success rate of P.PCI [3].

Many previous studies either classified old patients into a separate group without assessing its difference, especially those aged ≥ 75 [15], [16], [17] or are limited because of small number of old patients in their studies, or are only sub-group analysis derived from studies. In Vietnam, there have been only few studies about STEMI in the elderly. Therefore, we conduct this study to contribute clarifying the diagnosis, treatment and prognosis of P.PCI in STEMI patients aged ≥ 75 years old in clinical practice.

II. SUBJECTS AND METHOD

2.1. Subjects

Inclusion criteria: All patients aged ≥ 60 years old, who admitted to Gia Dinh People's hospital with the diagnosis of STEMI, underwent P.PCI within 12 hours from symptom onset, or extend within 18 hours from symptom onset with cardiogenic shock patients, from 03/2009 to 04/2015.

Exclusion criteria: STEMI patients underwent rescued or facilitated PCI, or P.PCI extend within 18 hours from symptom onset with cardiogenic shock patients.

2.2. Method

Study design: Retrospective, descriptive, cross-sectional study, convenience sampling.

Statistics: Analyzing data by SPSS 20.0 software. Utilizing t-test for quantitative variables, Chi-square test or Fisher for qualitative variables. P value < 0.05 is the chosen statistically significant threshold.

III. RESULTS AND DISCUSSION

In a total of 1100 STEMI patients undergoing P.PCI from 03/2009 – 04/2015, 500 STEMI patients (pts) aged ≥ 60 years old (45.4%) meet study criteria. We performed P.PCI to 492 STEMI pts (including 218 pts aged ≥ 75 years old and 274 pts aged from 60- 74 years old). There were 08 pts whose coronary anatomy was not suitable for P.PCI.

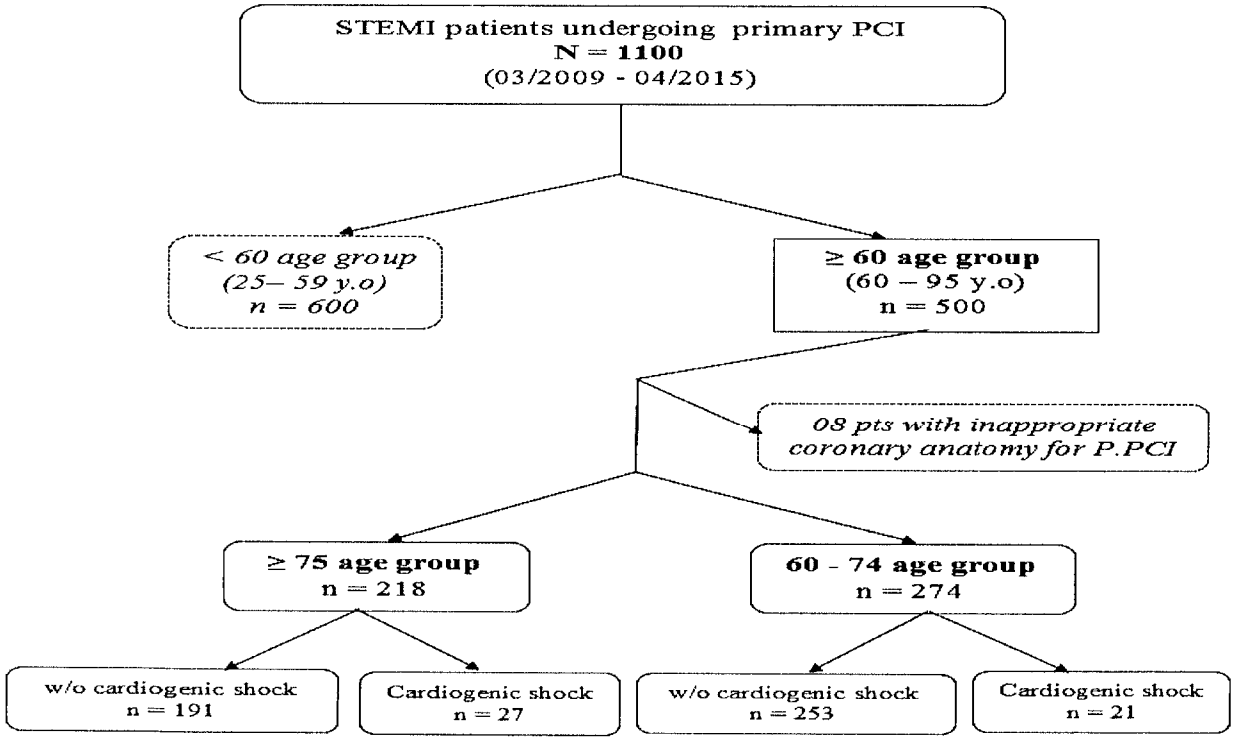

Fig.1: Flow chart for patient enrollment and follow-up

Table 1: General characteristics of study population

	Age (N= 500)		P
	60-74 n= 275	≥ 75 n= 225	
General characteristics			
Age (years)	66.7± 0.3	81.1± 0.3	< 0.001
Male	179 (65.1)	100 (44.4)	< 0.001
BMI (kg/m²)	22.6 ± 0.2	21.3 ± 0.2	< 0.001
Cardlovascular risk factors			
Hypertension	183 (66.5)	181 (80.4)	0.001
Type 2 diabetes	59 (21.5)	40 (17.8)	0.305
Dyslipidemia	128 (46.5)	98 (43.6)	0.504
Smoking	137 (49.8)	62 (27.6)	< 0.001
Familial history of premature CAD	14 (5.1)	11 (4.9)	0.918
Symptom onset – admission (minutes)			
Mean	189.5± 9.8	211.5 ±12.4	0.160
Median	140	160	
Acute heart failure and risk stratification			
TIMI risk score			<0.001
Low	183 (66.5)[a]	60 (26.7)[b]	
Intermediate	61 (22.2)[a]	90 (40.0)[b]	
High	31 (11.3)[a]	75 (33.3)[b]	
Killip classification			**0.0035**
I- II	248 (90.2)[a]	191 (84.9)[a]	
III	06 (2.2)[a]	90 (40.0)[b]	
IV	21 (7.6)[a]	32 (14.2)[b]	
Early complication of stemi before PCI			
High – degree AV block	14 (5.1)	18 (8)	0.19
Ventricular fibrillation	09 (3.3)	07 (3.1)	1.000
Cardiac arrest, successul resuscitation	04 (1.5)	03 (1.3)	1.000
Laboratory Characteristics			
Hs-CRP (mg/L)	38.3±14.7	123.1± 48.4	0.095
Hs- TnT (on admission) (ng/ml)	0.77±0.11	1.57± 0.21	< 0.001

Table 2 a: Coronary angiogram charactertistics

	Age (N= 500)		P
	60 -74 N= 275	≥ 75 N= 225	
Dominant coronary artery			**0.654**
Right	243 (88.4)	204 (90.7)	
Left	23 (8.4)	14 (6.2)	
Co-dominant	09 (3.3)	07 (3.1)	
Number of diseased arteries	2.03 ± 0.05	2.1 ± 0.05	0.214
Concomitant LM stenotic lesion ≥ 50%	07 (2.5)	14 (6.2)	0.041
Pre-PCI Timi- flow			0.563
0	181 (65.8)	135 (60.0)	
I	27 (9.8)	24 (10.7)	
II	52 (18.9)	53 (23.6)	
III	15 (5.5)	13 (5.8)	

Table 2b: Primary PCI Characteristics

	Age (N= 492)		p
	60 -74 N= 274	≥ 75 N= 218	
Post – PCI TIMI -flow			0.162
0	01 (0.4)	0 (0)	
I	0 (0)	0 (0)	
II	07 (2.6)	09 (4.1)	
III	266 (97.0)	209 (95.9)	
Door-to-balloon time (minutes)			
Mean	105.9 ± 4.7	110.2± 5.1	0.535
Median	87	93	
Percentage of door –to balloon time target accomplishment			
≤ 90 minutes	152 (55.5)	103 (47.2)	0.084
≤ 120 minutes	209 (76.3)	154 (70.6)	0.177
Success			
Angiographic	260 (94.9)	193 (88.5)	0.011
Procedural	249 (90.9)	168 (77.1)	< 0.001
Clinical	246 (83.5)	165 (75.7)	< 0,001

Table 3: Post- Primary PCI in – hospital events

	Age (N= 492)		
	60 -74 N= 274	**≥ 75 N= 218**	
Procedural complications	**11(4.01)**	**13 (5.96)**	**0.32**
Coronary dissection	01 (0.36)	01 (0.46)	
Residual thrombosis	01 (0.36)	02 (0.92)	
In –Stent thrombosis	01 (0.360	01 (0.46)	
No reflow	02 (0.73)	03 (1.38)	
Wire- induced perforation	01 (0.36)	02 (0.92)	
Balloon induced rupture	01 (0.36)	0 (0)	
Stent dislodgement	0 (0)	02 (0.92)	
Ventricular fibrilltion causing cardiac arrest	04 (1.46)	02 (0.92)	
In-Hospital events after PCI			
Cardiogenic	17 (6.2)	24 (11.01)	**0.058**
Refractory cardiogenic shock	04 (1.46)	06 (2.75)	
Acute hearfailure (killip III, IV)	08 (2.92)	06 (2.75)	
In-Stent thrombosis	01(0.36)	06 (2.75)	
Definite	01 (0.36)	01 (0.46)	
Probable	0 (0)	05 (2.29)	
Acute mitral regurgitation	0 (0)	02 (0.92)	
Septal perforation	02 (0.73)	0 (0)	
Cardiac tamponade	0 (0)	01 (0.46)	
V-fib after PCI	02 (0.73)	03 (1.38)	
Non cardiogenic	13 (4.7)	20 (9.2)	**0.07**
Stroke	0 (0)	03 (0.46)	
Severe sepsis – Septic shok	03 (0.36)	04 (1.83)	
Severe nosocomial pneumonia	05 (1.82)	07 (3.21)	
Severe acute exacerbation of Copd	03 (0.36)	02 (0.92)	
Severe GI Bleeding requiring blood transfusion	04 (1.46)	03 (0.46)	
Acute renal failure requiring hemodialysis	02 (0.73)	02 (0.92)	
Femoral hematoma requiring blood transfusion	01 (0.36)	02(0.92)	

Death	17 (6.20)	34 (15.60)	< 0.001
Cardiogenic	**13 (76.47)**	**18 (58.06)**	
Refractory cardiogenic shock	04 (23.53)	06 (17.65)	
Acute hearth failure	05 (29.41)	06 (17.65)	
Acute in-stent thrombosis	01 (5.88)	0 (0)	
Acute mitral regurgitation	0 (0)	02 (5.88)	
Septal perforation	01 (5.88)	0 (0)	
Recuerrent cardiac tamponade resulting from coronary rupture	01 (5.88)	0 (0)	
V-fib during PCI	0 (0)	01 (2.94)	
V-Fib after PCI	01 (5.88)	0 (0)	
Non-cardiogenic	03 (17.65)	11 (35.48)	
Stroke	0 (0)	03 (8.82)	
Severe nosocomial pneumonia	02 (11.76)	04 (11.76)	
Septic shock from GI tract infection	0 (0)	01 (2.94)	
Severe acute exacerbation of COPD	0 (0)	01 (2.94)	
Severe GI bleeding requiring bloodtransfusion	01 (5.88)	02 (5.88)	
Other causes	**01 (5.88)**	**05 (16.13)**	

Table 4: Patients without cardiogenic shock: Comparison between ≥ 75 and 60 – 74 age groups

	Age (N= 492)		**P**
	60 -74 N= 253	**≥ 75 N= 191**	
Symptom onset – admission (minutes)			
Mean	184.15±9.9	211.86 ± 12.6	0.08
Median	140	175	
Door-to-ballon time (minutes)			
Mean	102.67± 9.9	105.83 ± 5.3	0.67
Median	83	92	
Killip classification			**0.48**
I -II	247 (97.6)	189 (99)	
III	06 (2.4)	02 (1)	
TIMI risk score			< 0.01
Low	182 (71.9)[a]	60 (31.4)[b]	

Imtermediate	54 (21.4)[a]	87 (45.5)[b]	
High	17 (6.7)[a]	44 (23.1)[b]	
Coronary angiogram			
Multivessel disease	170 (67.2)	150 (78.5)	0.01
Left main disease	06 (2.4)	10 (5.2)	0.13
Pre-PCI TIMI -flow			0.22
0-I	02 (08)	0 (0)	
II	02 (08)	07 (3.7)	
III	249 (98.4)	184 (96.3)	
LABP	0 (0)	01 (0.5)	0.43
Success			
Angiographic	242 (95.7)	170 (89.0)	0.009
Procedural	237(93.7)	153 (80.1)	<0.001
Clinical	235 (92.9)	152 (79.6)	<0.001
In – hospital mortality	08 (3.2)	23 (12.0)	<0.001 or (1.74 – 8.33)

Table 5: Patients with cardiogenic shock: Comparison between ≥ 75 and 60 – 74 age groups

	Age (N=48)		**P**
	60-74 N= 21	**≥ 75 N=27**	
Symptom onset –admission (minutes)			
Mean	251.52 ± 45.0	185.5 ± 42.6	0.29
Median	164	107	
Door –to-balloon time (minutes)			
Mean	145.1 ± 17.1	134.48 ± 16.5	0.66
Median	130	126	
Coronary angiogram			
Multivessel disease	16 (76.2)	21 (77.8)	0.58
Leftmain disease	01 (4.8)	03 (11.1)	0.62
Pre PCI TIMI- flow			0.30
0-I	18 (85.7)	22 (81.5)	
II	03 (14.3)	03 (11.1)	
III	0 (0)	02 (7.4)	
Post –PCI TIMI -flow			0.64
0-I	0 (0)	0(0)	
II	03 (14.3)	02 (7.4)	
III	18 (85.7)	25 (92.6)	
LABP	03 (14.3)	03 (11.1)	0.74
Success:			
Angiographic	18 (85.7)	23 (85.2)	1.0
Procedural	12 (57.1)	15 (55.6)	1.0
Clinical	11 (52.4)	13 (48.1)	0.77
In – hospital mortaality	09 (42.9)	11(40.7)	0.88 OR 0.95 (0.49 -1.86)

General characteristics of study population

In our study, STEMI patients aged ≥ 75 are predominantly females (55.6%), with mean age at 81.1 ± 0.3 years old, which is higher than those of previous studies conducted in Vietnam by Nguyen Van Tan, Mai Ho Duy, at 69.2 ± 13.3 and 70.7 ± 6.8, respectively [1],[2].

Mean and median time from symptom onset to hospital admission in patients aged ≥ 75 years old is longer but statistically nonsignificant than the 60-74 age group (211.5 ± 12.4 minutes and 160 minutes versus 189.5 ± 9.8 minutes and 140 minutes; p = 0.16). The majority of patients aged 75 and older have intermediate and high TIMI scores (40% and 33.3%), and cardiogenic shock (Killip class IV) before P.PCI in this group is higher than that of younger group in our study (14.2% vs 7.8%). This Killip class IV result is even higher than that of *Vital Heart Response* registry (patients aged ≥ 75 vs those aged < 75: 8.5% vs. 5.1%, p<0.001) and EXAMINATION clinical trial of Ielasi A. et al (patients aged ≥ 75vs those aged <75: 3.3% vs. 0.8 %, p<0.001), [13],[20]. Results of our study are similar to previous studies that old age in STEMI patients is the prognostic factor for risk of severe acute heart failure, and cardiogenic shock.

Coronary angiographic, interventional characteristics and in-hospital events

We noted 08 cases in which coronary anatomy is not suitable for P.PCI, including 07 patients aged ≥ 75 (3.1%; 07/225 pts) and 1 patient aged 60-74 (0.4%; 01/275), p = 0.025. In these patients, culprit arteries are total occluded on coronary angiogram. After ballooning dotting or thrombus aspiration to restore coronary flow, these changes showed totally diffuse stenosis and/or severe calcified lesions, which are not appropriate for ballooning or stenting. This is also a specific feature of P.PCI in the elderly: coronary arteries are often tortuous, angulated, calcified and more diffusely stenotic than younger patients, which are not suitable for P.PCI.

Our study noted that TIMI flow 0-1 before P.PCI of (patients aged ≥ 75) las high rabe of (70.7%); multi-vessel disease (mean 2.1 ± 0.05), and concomitant left-main disease (6.2% vs 2.5%, p = 0.04) are more frequent than that of younger group. Our results are similar to *BREMEN STEMI* registry conducted on 5356 patients undergoing P.PCI[9]: the mean numbers of diseased coronary arteries of < 75, 75-85, and > 85 age groups are 1.8 ± 0.8; 2.1 ± 0.8; 2.1 ± 0.8; p < 0.0001; study of Ciszewski et al. [6] of P.PCI on 1.061 patients with STEMI, there was a higher percentage of patients with multi-vessel disease in the ≥ 75 age group compared to those aged < 75: 58.7% vs. 52.4%. Study of Nguyen Van Tan et al [2]: concomitant LM disease accounted for a higher proportion in patients aged ≥ 65 than in those aged < 65 (8.74% and 3.15%; p < 0.001). Multi-vessel disease and/or concomitant LM disease make P.PCI become more complex: choice of appropriate revascularization strategy, interventional technique, type of stent, as well as the increased risk of acute heart failure after P.PCI.

There is higher proportion of STEMI patients aged ≥ 75 requiring temporary pace-maker insertion (24.8%), but techniques of P.PCI, periprocedural complications, and in-hospital events in patients aged ≥ 75 show statistically nonsignificant difference when compared to those in 60-74 age group. However, rates of angiographic, procedural, and clinical success in those aged ≥ 75 are statistically significantly lower than those aged < 75, resulting in an increase in in-hospital mortality rate, which is 2.51 times higher in the older age group (15.6% vs. 6.2%; p < 0.001; OR 2.51; CI 95%: 1.44 – 4.38). Previous studies also showed that the older patients' age, a decrease in success rate of P.PCI [2][14][18]. We investigate cases having complication during P P.PCI and in-hospital mortality endpoint for all causes: all cases with no-reflow after P.PCI (5/5 pts) or coronary rupture (1/1pt) are fatal. Death is also experienced by 50% of cases with

definite acute in-stent thrombosis (1/2 pts), stent dislodgement (1/2 pts) and ventricular fibrillation (3/6 pts); 33% of cases with coronary perforation (1/3 pts) and residual thrombus (1/3 pts).

In our study, the total percentages of cardiogenic and non-cardiogenic in-hospital mortality in patients aged ≥ 75 are higher but statically nonsignificant than those aged < 75 (p=0.26).Cardiogenic in-hospital events of the old and younger age groups are 11.01% and 6.2%, respectively; p = 0.058; OR 1.87; CI 95%: 0.98- 3.58. Acute heart failure and refractory cardiogenic shock after P.PCI account for the highest proportions of cardiogenic events, at 50% (12/24 pts) in group ≥ 75 and 70.6% (12/17 pts) in group aged 60 – 74, respectively.Rates of severe non-cardiogenic events of the two groups are 9.2% and 4.7%, respectively; (p = 0.07; OR 1.93; CI 95%: 0.98 – 3.8). Severe nosocomial pneumonia accounts for the largest in both ≥ 75 and 60 - 74 age groups, at 35% (07/20 pts) and 38.5% (05/13 pts), respectively. Septicemia and septic shock are the second most common causes, with rates at 20% (04/20 pts) and 23% (03/13 pts). Study of Ciszewski et al [6] assessed the efficacy of P.PCI on 1061 STEMI patients , included 2 groups: ≥ 75 years old and < 75 years old: rate of in-hospital events (stroke, major hemorrhage, and reinfarction) are similar (p > 0.05) between ≥ 75 and < 75 age groups, including death (11.8% vs. 3.0%); stroke (0.8% vs. 0.6%); major hemorrhage (5% vs. 3.3%).

Although successful P.PCI isperformed for the elderly, in hospital fatal risks still exist, which requires focus on the improvement of treatment efficacy in this group. Therefore, it is vital to improve interventional techniques, and prevent periprocedural complications, especially in old STEMI patients.

P.PCI in the elderly with cardiogenic shock

In our study, when assessing cases of STEMI without cardiogenic shock, those aged ≥ 75 undergoing P.PCI still have worse outcome, with in-hospital mortality 3.81 times higher than that of patients aged 60-74 (12% vs 3.2%, p < 0.001, OR =3.81, CI 95%: 1.74 - 8.33). Meanwhile, there is not any statistically significant difference in in-hospital mortality rate in STEMI patients with cardiogenic shock between ≥ 75 and 60-74 age groups (42.9% vs. 40.7%; p= 0.88; OR:0.95; CI 95%: 0.49-1.86). It is remarkable that characteristics of symptom onset-hospital admission time, door-to-balloon time, median door-to-balloon time, multi-vessel disease, concomitant LM disease, IABP insertion between the 2 age groups are statistically nonsignificant. Results from assessment of rates of angiographic (85.2% vs. 85.7%; p = 1.0), procedural (55.6% vs. 57.1%; p = 1.0) and clinical success (48.1% vs. 52.4%; p = 0.77) also show no statistically significant difference between 02 groups.

SHOCK trial of Dzavik et al. assessing results of STEMI with cardiogenic shock illustrates the in-hospital mortality rate of < 75 and ≥ 75 age groups were 38.5% and 45.2%, respectively; p = 0.393 [8].

The result of mortality rate in our study suggests that in elderly patients presenting with cardiogenic shock complicating from STEMI, P.PCI can offer survival improvement when compared to conservative medication therapy (in-hospital mortality of patients with Killip IV at 81%), and this statement is also applicable to patients aged ≥ 75 years old.

IV. CONCLUSION

In elderly patients presenting with STEMI, P.PCI is the first-line therapy because of its efficacy regardless of age. In addition, it is necessary to balance between patients' comorbidity, the risks and the benefit of P.PCI procedure. In patients with cardiogenic shock complicating from STEMI, the older they are, the higher the mortality rate is; but they also experience the greatest benefit of mortality reduction.

REFERENCE

1. Mai Hồ Duy (2011), *Nghiên cứu sự hiệu quả và an toàn của phương pháp can thiệp động mạch vành qua da ở người cao tuổi bị hội chứng vành cấp tại Viện Tim TP.Hồ Chí Minh*, Luận văn Thạc sĩ Y học, chuyên ngành Nội - Lão khoa, Khoa Y, Đại học Y Dược TP.Hồ Chí Minh, TP.Hồ Chí Minh.
2. Nguyễn Văn Tân (2015), *Sự khác biệt về lâm sàng, cận lâm sàng và điều trị nhồi máu cơ tim cấp ở bệnh nhân trên và dưới 65 tuổi* Luận án Tiến sĩ Y học, chuyên ngành Nội – Tim mạch, Khoa Y, Đại học Y Dược TP. Hồ Chí Minh, TP.Hồ Chí Minh.
3. Antman, E. M., Valenti, R., Moschi, G., và al., et (1997), "Acute myocardial infarction", *Heart Disease*, W.B Saunders company, Philadelphia / London, pp. 1184-1266.
4. Bonetti, P. O. , Zellweger, M. J., Kaiser, C., và Pfisterer, M. E. (2009), "Acute Coronary Syndromes in Specialgroups of Patients", *Acute Coronary Syndromes*, Blackwell Publishing Ltd, pp. 95 - 105.
5. Brieger, D., et al. (2004), "Acute coronary syndromes without chest pain, an underdiagnosed and undertreated high-risk group: insights from the Global Registry of Acute Coronary Events", *Chest.* 126(2), pp. 461-9.
6. Ciszewski, A., et al. (2008), "Primary angioplasty in patients > or = 75 years old with ST-elevation myocardial infarction - one-year follow-up results", *Kardiol Pol.* 66(8), pp. 828-33; discussion 834-6.
7. Christiansen, E. C., et al. (2013), "Comparison of functional recovery following percutaneous coronary intervention for ST elevation myocardial infarction in three age groups (<70, 70 to 79, and >/=80 years)", *Am J Cardiol.* 112(3), pp. 330-5.
8. Dzavik, V., et al. (2003), "Early revascularization is associated with improved survival in elderly patients with acute myocardial infarction complicated by cardiogenic shock: a report from the SHOCK Trial Registry", *Eur Heart J.* 24(9), pp. 828-37.
9. Fach, A., et al. (2015), "Comparison of Outcomes of Patients With ST-Segment Elevation Myocardial Infarction Treated by Primary Percutaneous Coronary Intervention Analyzed by Age Groups (<75, 75 to 85, and >85 Years); (Results from the Bremen STEMI Registry)", *Am J Cardiol.* 116(12), pp. 1802-9.
10. Gharacholou, S. M., et al. (2011), "Age and outcomes in ST-segment elevation myocardial infarction treated with primary percutaneous coronary intervention: findings from the APEX-AMI trial", *Arch Intern Med.* 171(6), pp. 559-67.
11. Goldberg, R. J., et al. (2002), "Extent of, and factors associated with, delay to hospital presentation in patients with acute coronary disease (the GRACE registry)", *Am J Cardiol.* 89(7), pp. 791-6.
12. Holay, M. P., et al. (2007), "Clinical profile of acute myocardial infarction in elderly (prospective study)", *J Assoc Physicians India.* 55, pp. 188-92.
13. Ielasi, A., et al. (2015), "Everolimus-eluting stent versus bare-metal stent in elderly (>/=75 years) versus non-elderly (<75 years) patients with ST-elevation myocardial infarction undergoing primary percutaneous coronary intervention: insights from the examination trial", *Int J Cardiol.* 179, pp. 73-8.
14. Lazzeri, C., et al. (2013), "Trends in mortality rates in elderly ST elevation myocardial infarction patients submitted to primary percutaneous coronary intervention: a 7-year single-center experience", *Geriatr Gerontol Int.* 13(3), pp. 711-7.
15. Leal, M. F., et al. (2002), "Acute myocardial infarction in elderly patients: comparative

analysis of the predictors of mortality. The elderly versus the young", *Arq Bras Cardiol.* 79(4), pp. 363-74.

16. Rich, M. W. (2004), "Cardiac Disease", *Current Geriatric Diagnosis and Treatment*, McGraw-Hill companies, pp. 156 - 182.
17. Rich, M. W., et al. (1992), "Is age an independent predictor of early and late mortality in patients with acute myocardial infarction?", *Am J Med.* 92(1), pp. 7-13.
18. Shiraki, T. và Saito, D. (2011), "Clinical features of acute myocardial infarction in elderly patients", *Acta Med Okayama.* 65(6), pp. 379-85.
19. Simms, A. D., et al. (2012), "Acute coronary syndromes: an old age problem", *J Geriatr Cardiol.* 9(2), pp. 192-6.
20. Toleva, O., et al. (2015), "Treatment choices in elderly patients with ST: elevation myocardial infarction-insights from the Vital Heart Response registry", *Open Heart.* 2(1), p. e000235.