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Health-Related Quality of life of Complete versus Infarct artery-only Percutaneous Coronary Revascularization in Multi-vessel Disease with ST-Segment Elevation Myocardial Infarction

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Abstract

Objective: The aim of this study was to evaluate the health-related quality of life (HRQoL) as measured by the EQ-5D (European quality of life-5 dimensions) self-report questionnaire in patients treated with complete revascularization versus infarct artery-only revascularization at index admission.

Background: The revascularization strategies for multivessel disease while undergoing primary percutaneous coronary intervention (P-PCI) on HRQoL is uncertain.

Methods and Results: STEMI patients with multivessel disease underwent either complete or between April 1, 2012, and March 31, 2014, were subdivided into those who underwent complete revascularization (n = 133) or infarct-related artery (IRA)-only revascularization (n = 139) at index admission. The EQ-5D assessed mobility, self-care, usual activity, pain or discomfort, and anxiety or depression. Patient groups were differed at baseline by gender and prevalence of heart failure. At 2-year follow-up, both mean (±SD) EQ-VAS and EQ-5D utility scores were lower for patients who underwent complete revascularization versus infarct artery-only revascularization (60.00 (±18.8) vs. 59.03 (±16.9), P < 0.03, and 0.68 (±0.02) vs. 0.54 (±0.02), P<0.004, respectively).

Conclusion: The clinically significant improvement in QoL was seen in the complete revascularization group compared with treating only the IRA at 24 months.

Keywords: QoL; Complete revascularization; Infarct-related artery; Primary percutaneous coronary angioplasty; ST-segment elevation patients; Multi-vessel disease patients

Introduction

Primary percutaneous coronary intervention (P-PCI) is one of the procedures of revascularization for patients with ST-segment elevation myocardial infarction (STEMI) [1]. During index angiography, about 30% of patients with multi-vessel disease (MVD) have ≥ 70 % stenoses seen in 1 or more non–infarct-related arteries (N-IRA) having an adverse prognostic predictor of long-term outcome such as major adverse cardiac events (MACE) [2] .

Complete versus infarct artery-only in STEMI with MVD

Current guidelines recommend treating STEMI patients presented with MVD with percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) [3]. The purpose of PCI in patients with STEMI and MVD is to restore epicardial flow and myocardial perfusion in the significantly narrowed artery(ies) [3,4] The severity in narrowing of arteries varies from patient to patient.9 In acute STEMI patients presented with MVD, the completely occluded coronary artery which caused the MI is referred to as a 'infarct artery'; while the remaining significantly occluded coronary artery(ies), which did not cause the MI are referred as 'non-infarct artery(ies)'.(5) PCI for acute STEMI with MVD can be either "complete revascularization" or "infarct artery-only revascularization"[6] . "Infarct artery-only revascularization" is a type of PCI revascularization strategy, which is performed only in the infarct artery that caused the MI at the time of patient's index admission for MI. [7] "Complete revascularization" which includes not only the infarct artery revascularization at the time of patients' index admission for MI, but also revascularization of non-infarct artery(ies). Some interventionists, do primary PCI for infart artery-only and medication and will consider revascularization for non-infarct arteries only if the patients' symtptoms worsens [8,9] . Evaluating the effectiveness

and efficacy of opening of all siginificantly stenosed arteries i.e., complete revascularization during primary PCI for an acute STEMI with infarct artery-only in patients with MVD is under constant investigation, [10-15] but there are only limited studies regarding health related quality of life (HRQoL), may play a significant role in selecting revascularization strategy [16].

The aim of this study was to compare in HRQoL as measured by the EQ-5D (European quality of life-5 dimensions) self-report questionnaire in patients treated with complete revascularization versus infarct artery-only revascularization.

Methods

Study Design and Oversight

The study utilized an observational, retrospective cohort design conducted between April 1, 2012, to March 31, 2014, at a tertiary care hospital from Yerevan, Armenia. The detailed study design and the inclusion and exclusion criteria have been described previously [17]. All multivessel disease patients who experienced a STEMI within 24 hours before undergoing PCI using either complete revascularization versus infarct artery-only revascularization included in our study. All patients were written consented to the procedure. The study was conducted according to the Declaration of Helsinki and approved by the Institutional review board.

Inclusion Criteria

• The study enrolled all acute STEMI patients with MVD that had primary PCI at our cardiac center during the study period.
• Patients who received complete revascularization by PCI at the index admission were included in complete PCI group [18,19] . The infarct artery-only PCI group included patients who underwent PCI at the index admission for the infarct artery-only [20]. Non-culprit artery(ies) that needed revascularization was defined as any coronary artery with >50% narrowing [21].

Exclusion Criteria

• Prior CABG surgery or PCI.(9)
• Patients with missing medical records
• Patients with missing contact information
• Patients who did not speak Armenian
• Patients who were not residing in Armenia
• Patients who did not consent to study

Measurement of Health Related Quality of Life

Data from all patients with STEMI were prospectively recorded in a computerized database as part of the catheterization laboratory registry, regarding demographic data; pre-procedural risk factors; periprocedural complications; types of devices used; an extent of disease and lesions treated. These data were recorded at the time of the procedure and discharge by catheterization laboratory personnel. A telephone interviewer-administered structured questionnaire was used to collect data about HRQoL. Telephone interviewers were blinded about which group the patient belonged.

The EQ-5D is a five-item instrument that assesses mobility, self-care, usual activity, pain or discomfort, and anxiety or depression, with each dimension having three levels of perceived problems: no problems (level 1), some problems (level 2), and extreme problems (level 3) [22] .For this study, individual domain scores were converted to a summary index representing utility weights for the Armenian population [23] . An overall utility score are measures on a scale from 0 to 1 of a patient's strength of preference of their health status, where 0 representing "worst health state" usually death and 1 representing "ideal health state."[24]

Statistical analysis

All statistical analyses were performed using the Stata14 software package (StataCorp. 2015. Stata Statistical Software: Release12. College Station, TX: StataCorp LP). The patients were stratified into two groups: complete revascularization versus infarct artery-only revascularization at baseline. Descriptive data obtained through EQ-5D questionnaire were reported as frequencies and percentages of patients having particular levels in particular dimensions. The frequencies of reported level 3 problems in this study were very low (<2% of total patients), hence for convenience, the levels were dichotomized into "no problems" (level 1) and "any problem" (levels 2 and3), thereby converting dimensions into frequencies of reported problems [25]. The differences in reported problems between complete revascularization and infarct artery-only revascularization were compared using chi-square test. An independent t-test was used to detect differences between mean ± SD of EQ VAS scores and EQ5D utility scores for patients with complete revascularization and infarct artery-only revascularization.
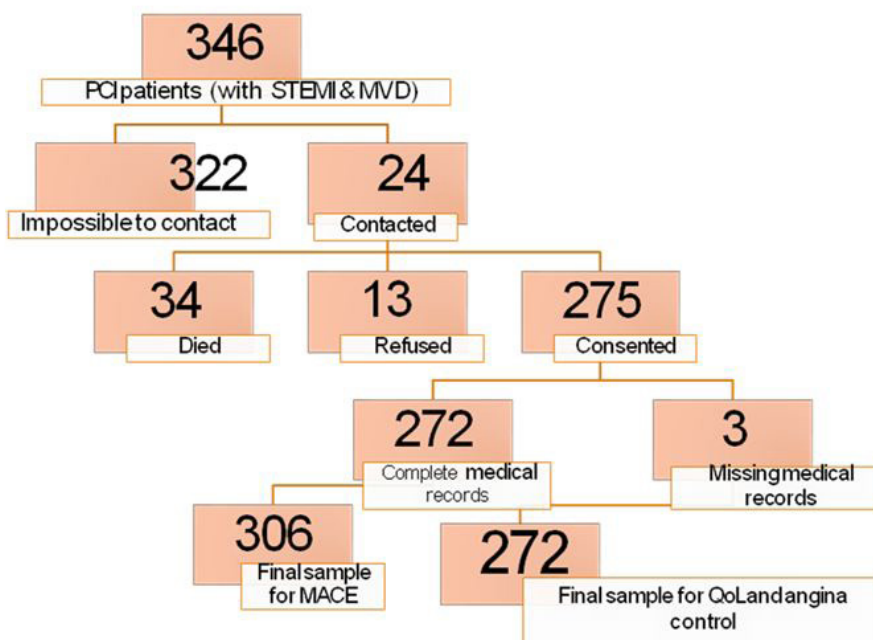
To assess the predictors of the EQ VAS and utility scores, multivariate stepwise linear regression models were used. The independent variables studied include age, the presence of hypertension, diabetes, sex, MACE, number of vessels involved and type of PCI revascularization.

Odds ratios (ORs; 95% confidence intervals, 95% CIs) for reporting problems in all the five EQ-5D questionnaire dimensions were calculated using binary regression for patients underwent complete revascularization versus infarct artery-only revascularization. **P** <0.05 was considered statistically significant, whereas P< 0.001 was considered statistically highly significant.

Results

Of 346 patients with STEMI and MVD who underwent primary PCI enrolled in the cohort study, 272 patients responded to the HRQOL questionnaire on a average of 2-year follow-up after an PCI revascularization. Out of 346, 322 patients were contacted, and 24 patients could not be contacted (out of the country, wrong numbers, no responders, missing numbers, etc). Of the 322 patients/relatives contacted by phone, 34 patients had died, 13 refused to participate and 275 patients were consented. Of the 275 consented patients, 272 patients had complete medical records and 3 patients' medical records were missing. The final sample available for the survival analysis was 306 and for the QOL and angina control analyses was 272. (Chart 1)

Study Flow

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                          346
                PCI patients (with STEMI & MVD)

           322                    24
     Impossible to contact     Contacted

      34          13          275
     Died      Refused     Consented

              272                      3
       Complete medical          Missing medical
           records                  records

      306                272
  Final sample      Final sample for QoL and angina
   for MACE                     control
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Baseline clinical characteristics

Out of 272 patients with the multi-vessel disease who underwent angioplasty within 12 h of AMI, 139 (51%) received IRA-only PCI, and 133 (49%) received complete revascularization. There were more females in the IRA-only PCI group than in the complete revascularization group (86.4% versus 71.9%, P =0.003). Regarding co-morbidities, the complete revascularization group was more likely to suffer from heart failure, and diabetes. The patients in the IRA-only group were more likely to have a prior MI. The groups were similar concerning left ventricular ejection fraction and type of stent used during the procedure. Patients' baseline characteristics stratified by PCI procedural types are presented in (Table 1 and Table 2)

Health Related Quality of Life Outcomes

Findings from outcomes of each of the five dimensions of the EQ-5D questionnaire are given in Table 3.

Differences in the dimensions between complete and infarct artery-only revascularization were observed for the anxiety/ depressions domain infarct artery-only revascularization group were significantly better compared with complete revascularization (p<0.02). Infarct artery-only patients were likely to experience more difficulties or problems compared with complete revascularization for all the EQ-5D dimensions, except for mobility and doing usual activities. A significantly higher proportion of infarct artery-only revascularization (vs. complete revascularization) reported self-care (33.0%vs.38.0%), as well as anxiety or depression (59.3% vs. 69.3%) (P <0.005 in each case).

EQ VAS and EQ-5D Utility Scores

At 2-year follow-up, both mean (±SD) EQ VAS and EQ-5D utility scores were lower for patients who underwent complete revascularization versus infarct artery-only revascularization (60.00 (±18.8) vs. 59.03 (±16.9), P < 0.03, and 0.68 (±0.02) vs. 0.54 (±0.02), P<0.004, respectively).

Table 4 shows findings of the multivariate stepwise linear regression models used to assess the variables that influence on 2-year EQ VAS and EQ-5D utility scores.

Characteristics	Complete revascularization n=133	Infarct artery-only PCI n=139	P value
Demographic characteristics			
Male	115 (86.4)	100 (71.9)	0.003
Age (years),mean (SD)	64.9(5.3)	64.1(5.6)	0.25
Risk factors and comorbidities			
BMI (kg/m², mean(SD)	29.0 (5.6)	28.6 (5.4)	0.59
Smoking status at PCI, n (%)	21 (15.7)	20 (14.3)	0.14
Diabetes, n (%)	33 (24.8)	31 (22.3)	0.31
Hyperlipidemia, n (%)	29 (21.8)	30 (21.5)	0.02
Hypertension, n (%)	97 (72.9)	99 (71.2)	0.4-
Cerebrovascular disease, n (%)	5 (0.3)	3 (0.2)	0.66
GI disease, n (%)	16 (12.0)	22 (15.8)	0.68
COPD, n (%)	3 (0.2)	2 (0.1)	0.27
Cardiacstatus			
Anterior MI, n (%)	28 (21.0)	30 (21.5)	0.78
Unstable angina, n (%)	109 (81.9)	108 (77.6)	0.33
History of MI, n (%)	50 (37.5)	51 (36.6)	0.09
MI status by Troponin level, n (%)			
Probable MI	79 (59.3)	98 (70.5)	0.07
LVEF by CMR (%), mean (SD)	45.5 (3.9)	46.0 (4.0)	0.23

Table 1: Patient baseline characteristics
BMI: body mass index; PCI: percutaneous coronary intervention; GI: gastrointestinal; COPD: chronic obstructive pulmonary disease; MI: myocardial infarction; LVEF: left ventricular ejection fraction; CMR: cardiac magnetic resonance

Characteristics	Complete revascularization	Culprit artery-only revascularization	P value
Hemodynamic unstability	n=133	n=139	
Unstable	4(0.3)	5(0.3)	0.46
Killip class II/III on admission	8(0.6)	12(0.8)	0.51
TIMI flow grade ≤ 2 in IRA	62(46.6)	79(56.8)	0.005
Number of diseased vessels, n (%)			
Two	115(86.4)	112 (80.5)	0.63
Three	25 (18.7)	30 (21.5)	
Door to balloon time(min), mean (± SD)	192 (45.2)	163 (30.8)	<0.001
Stent approach, n (%)			
Radial	113 (84.9)	116 (83.4)	0.56
Femoral	20 (15.0)	23 (16.5)	
PCI treated culprit arteries, n (%)			
Proximal RCA	28 (18.7)	25 (15.0)	0.54
Mild RCA*	22 (14.7)	16(10.2)	0.24
LMS	0 (0)	0 (0)	-
Proximal LAD	27(18.0)	29 (18.6)	0.60
Mild LAD	21 (14.0)	14 (9.0)	0.15
Proximal circumflex	9 (6.0)	14 (9.0)	0.32
Other arteries	18 (12.0)	26 (16.7)	0.24

Characteristics	Complete revascularization	Culprit artery-only revascularization	P value
PCI treated non-culprit arteries, n (%)			
Proximal RCA	24(12.4)	28(18.2)	0.65
Mild RCA*	43(22.3)	19(12.3)	0.001
LMS	1(0.5)	2(1.3)	0.58
Proximal LAD	28(14.5)	54(35.1)	0.005
Mild LAD	46(23.8)	36(23.4)	0.21
Proximal circumflex	30(21.6)	1(0.7)	<0.001
Other arteries	21(4.7)	14(8.1)	0.16
Number of stents placed, mean (SD)	2.12(0.5)	1.12(0.4)	<0.001
Non-IRA lesions			
CTO	48(32.0)	52(33.3)	<0.001
Distal or secondary branches	31(21.0)	28(18.0)	0.004
Discharge medication, n (%)			
Antiplatelets	131 (90.7)	136 (97.4)	0.86
BBs	92 (61.3)	96 (64.0)	0.84
ACEi/ARBs	91(60.7)	92 (9.0)	0.597
Calcium blockers	37 (24.7)	39 (25.0)	0.971
Statins	1(0.7)	0(0.00)	0.302
Diuretics	29(19.3)	21 (13.5)	0.141

Table 2: PAngiographic characteristics of coronary arteries
*Stenosis ≥70%.
PCI: percutaneous coronary intervention; CTO: chronic total occlusion; RCA: right coronary artery; LMs: left main stem coronary artery; LAD: left anterior descending; ACE: angiotensin-converting enzyme

Dimension	Complete revascularization N=133	Infarct artery-only revascularization N=139	P value
Mobility, n (%)	90 (67.6)	92 (66.1)	0.02
Self-care, n (%)	44 (33.0)	54 (38.8)	0.01
Usual activities, n (%)	93 (69.9)	79 (56.8)	0.04
Pain/discomfort, n (%)	100 (75.1)	110 (79.1)	0.25
Anxiety/depression, n (%)	79 (59.3)	89 (63.3)	0.02
Current health status, mean VAS (±SD)	60.00 (±18.8)	59.03 (±16.9)	0.03
QoL health utility score, mean (±SD)	0.68 (±0.02)	0.54 (±0.02)	0.004

EQ-5D, EuroQol five-dimensional; QoL, Quality of life.
Table 3: Proportion of patients reporting problems on each EQ-5D questionnaire dimensions on an average of 2-year follow-up

Variables	Partial regression coefficient	SE	P
Dependent variable: EQ VAS score*			
Complete vs. infarct-only artery revascularization	-1.192	2.077	0.005
Three vessel disease (reference: Two vessel disease)	-3.241	2.454	0.001
Hypertension	-2.561	2.362	0.002
Dependent variable: EQ-5D questionnaire utility score†			
Complete vs. infarct-only artery revascularization	-.081	.129	0.02
Three vessel disease (reference: Two vessel disease)	-.056	-.056	0.001
Hypercholesterolemia	-.237	.155	0.004

Table 4: Predictors of EQ VAS and EQ-5D questionnaire utility scores at 2-year follow-up
Independent variables studied: age (<65 vs. >65 years), hypertension (present vs. absent), diabetes (present vs. absent), sex (male vs. female), MACE (present vs. absent), number of vessels involved (three vs. two) and PCI intervention (complete revascularization vs. infarct-only arterty revascularization), and use of key evidence-based medication (antiplatelet agent, beta-blocker, antihyperlipidemic agent, and ACEI/ARB).
ACEI/ARB, angiotensin-converting enzyme inhibitors or angiotensin receptor blockers; CHF, congestive heart failure; EQ-5D, EuroQol five-dimensional; MACE, major adverse cardiac event; PCI, percutaneous coronary intervention; VAS, visual analogue scale.
* R =0.09, R^2=0.14 adjusted R2= 0.11, F = .41, P= 0.04.
† R=1.09, R^2=0.09 adjusted R2=0.04, F = 2.32, P=0.03

The presence of infarct artery-only revascularization, more number of diseased vessels showed statistically highly significant negative correlation (P <0.001) with 2-year EQ VAS and EQ5D utility scores. Complete revascularization influenced the EQ VAS score (P <0.05 in each case), whereas presence of hypertension were associated with worse EQ-5D utility scores at 2 year.

Binary regression models demonstrated that infarct artery-only revascularization at baseline was associated with reporting of more difficulties in patients with STEMI with MVD at 2-year follow-up for all EQ-5D questionnaire dimensions, except doing usual activities (mobility: OR 1.7 [95% CI 1.1–12.0]; self-care: OR 1.3 [95% CI 1.1–2.3]; pain/discomfort: OR 2.1 [95% CI 1.8–5.4.]; anxiety/depression: OR 2.4.1 [95% CI 1.3-3.8]).

Discussion

The ultimate goal of the intervention strategy for the MVD with STEMI is to increase the length of life and quality of life. Clinical outcomes which have been studied intensively, but there is only limited studies on quality of life[26] . Studies have shown that the survival time for patients treated by complete revascularization PCI was more prolonged than those treated by infarct-related artery-only revascularization[20].

Recently, the quality of life is now increasingly used as a factor in the evaluation of clinical efficacy and long-term prognosis [27]. To our knowledge, this is the first study to evaluate patients' QoL after complete versus infarct artery-only revascularization in patients with STEMI and MVCAD from Eastern Europe and Central Asia. Our study revealed interesting patterns for MVD during a STEMI were more likely male, less likely to have diabetes, or proximal left anterior descending artery lesion were treated more aggressively with the complete revascularization. Most likely, this strategy may be because of the belief that these patients may have lower procedural risk than the sicker population. Our findings underline the importance of this critical outcome for future trials, to compare these 2 revascularization strategies and to evaluate the effects of revascularization strategy on QoL [28].

Cuurrent guidelines recommended against the revascularization of the non-infarct artery unless hemodynamic compromise or residual ischemia is present [29].Our study shows that better disease-specific QoL, is associated with complete revascularization as in other studies [20]. To definitely prove this, perhaps, randomized trials that systematically measure patients' health status are needed.

Study limitations

One of the possible limitations of the study was that this is a retrospective study comprising non-randomized patients, subject to selection bias, no information regarding missing data can be provided. The sample represents responders from a single center with a modest sample size, indicating that patients who underwent PCI at other hospitals were not included in the study. Hence, the results are more applicable to the center where the study is conducted. The strength of our study was that the interviewers were blinded about which group the patient belonged. Thus, the assessment of the outcomes was blinded. Albeit most of the known risk factors were considered in models assessing predictors for EQ VAS and EQ-5D utility scores, the small values of adjusted R2 warrant further studies to other possible risk factors. Lastly, baseline analysis should be conducted to draw clear conclusions.

Conclusion

The current study assessed the difference in 2-year health realated QoL among patients with MVD and STEMI, who had undergone either complete revascularization or IRA-only PCI. The clinically significant improvement in QoL was seen in the complete revascularization group at 2-year. Considering the fact that both of the PCI types are still in use, more studies are needed to show the harms and benefits of each type and studies utilizing pre-post designs should be conducted to draw clear conclusions.

Conflict of interest

The authors have no conflict of interest to disclose.

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