Comparative Effectiveness of Complete Versus Culprit Artery Only Percutaneous Coronary Revascularization for Multivessel Disease after ST-Segment Elevation Myocardial Infarction

(A Retrospective Cohort Study)

Master of Public Health Integrating Experience Project

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By

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LIST OF ABBREVIATIONS

ACC	American College of Cardiology
ACEi	angiotensin-converting enzyme inhibitors
AHA	American Heart Association
ARB	angiotensin receptor blockers
BMS	bare-metal stent
CABG	coronary artery bypass graft
CAD	coronary artery disease
COPD	chronic obstructive pulmonary disease
CV	cardiovascular
DES	drug eluting stent
ECG	electrocardiogram
GI	gastrointestinal disease
IRB	Institutional Review Board
LAD	left anterior descending
MACE	major adverse cardiac events
MI	myocardial infarction
MVD	multivessel disease
NMMC	Nork Marash Medical Center
NSTEMI	non- ST-segment elevation myocardial infarction
PCI	percutaneous coronary intervention
QoL	quality of life
STEMI	ST-segment elevation myocardial infarction

VAS	visual analogue scale
WHO	World Health Organization

Abstract

Background: Coronary artery disease (CAD) is the leading cause of mortality and morbidity in the world. Percutaneous coronary intervention (PCI) is one of the treatment approaches for CAD. PCI can be conducted for the completely blocked artery and the remaining angiographically significantly narrowed arteries (complete PCI), or it can be done only for the completely blocked artery (culprit artery-only PCI). The clinical benefits of complete PCI versus culprit artery-only PCI are debatable. This study compared the event free survival from major adverse cardiac events (MACE), angina control and quality of life in patients who underwent complete PCI or culprit artery-only PCI at two years follow-up in a single tertiary center, Yerevan, Armenia.

Methods: A retrospective cohort study was conducted. The study population included all multivessel disease (MVD) patients after ST-segment elevation myocardial infarction (STEMI), who underwent primary PCI from 2012 to 2014 at Nork Marash Medical Center (NMMC). Data were collected from patient telephone surveys (March-April 2015), the NMMC electronic PCI database, and medical records. Multivariable Cox proportional hazards regression analysis was used to compare survival rates between complete and culprit artery-only PCI groups.

Results: Among 306 patients included in the analysis, 150 (49.01%) patients underwent complete PCI and 156 (50.99 %) underwent culprit artery-only PCI. The groups differed at baseline by gender and prevalence of heart failure. The average door-to-balloon time was significantly higher in the complete PCI group. The mean follow-up time was 28.5 months for the complete PCI and 26.8 months for the culprit artery-only groups. In unadjusted comparisons, the complete PCI groups had higher quality of life score (measured by EQ-5D health utility

score) and better angina control (measured by composite angina score), than the culprit-only PCI group. After adjustment for the number of diseased vessels (2 versus 3 vessel disease) and hypertension, the hazard of developing MACE was higher in culprit artery-only PCI group (HR=0.45 for complete PCI versus culprit artery-only PCI, 95% CI: 0.21-0.93).

Conclusion: At 2-year follow-up, complete PCI resulted in better clinical outcomes compared with treatment of the culprit artery-only PCI. In unadjusted analysis, quality of life and angina control were significantly better in the complete PCI group compared to culprit only-PCI group. In the future, the STEMI guideline committees may take this study into consideration in regards to treating significant non-culprit artery stenosis in patients with STEMI and MVD undergoing primary angioplasty. Studies with larger sample size and multi-centered studies are needed to replicate these results.

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1. INTRODUCTION

Disease burden

Coronary artery disease (CAD) remains the leading cause of morbidity and mortality worldwide.[1] According to World Health Organization (WHO), in low- and middle-income countries over 80% of deaths take place due to CAD and occur almost equally in men and women.[2] CAD is the atherosclerosis of coronary arteries and can be asymptomatic or can represent as a stable angina, unstable angina, myocardial infarction (MI) or sudden cardiac death.

Clinical representation of STEMI with MVD

MI occurs when a coronary artery is completely blocked, creating a serious reduction in the blood flow and causing some of the heart muscle being supplied by that artery to become infarcted.[3] MI is divided into two types according to its severity – ST-segment elevation myocardial infarction (STEMI) and non-ST-segment elevation myocardial infarction (NSTEMI).[4] Acute ST-segment elevation myocardial infarction (STEMI) is a major cause of morbidity, mortality, and disability worldwide. It occurs when the blood clot completely blocks a coronary artery, and as a result virtually all the heart muscle that is supplied by the affected artery starts to die. STEMI is recognized by its characteristic changes on the electrocardiogram (ECG).[5] One of those ECG changes is the typical elevation of the ST segment on the ECG.[3,4] It is estimated that 40% to 65% of the patients presenting with STEMI have multivessel disease (MVD), which has been associated with worse clinical outcomes as compared with single-vessel disease.[6,7] STEMI is associated with a higher risk of short-term mortality when compared to NSTEMI, and requires early revascularization.[8]

Management of STEMI with MVD

Current clinical practice 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).[9,10]

Comparison between complete and culprit artery-only PCI

The severity in narrowing of arteries varies from patient to patient.[9] In acute STEMI patients presented with MVD, the completely blocked coronary artery which caused the MI is referred to as a 'culprit artery'; while the remaining partially blocked coronary artery(ies), which did not cause the MI are referred as 'non-culprit artery(ies)' respectively.[6] PCI for acute STEMI with MVD can be either "complete PCI" or "culprit artery-only PCI".[11] "Culprit artery-only PCI" is a type of PCI revascularization procedure, which is performed only in the culprit artery that caused the MI at the time of patient's index admission for MI.[12] "Complete PCI" is a complex of revascularization procedures, which includes not only the culprit artery revascularization at the time of patient's index admission for MI, but also revascularization of non-culprit artery(ies) within 60 days from the first PCI procedure.[3] PCI is usually performed by an interventional cardiologist.[3] Following the PCI for culprit artery at the index admission, some interventionists will treat the STEMI patients with MVD exclusively with medication therapy, and will consider revascularization of non-culprit arteries only if the patient has worsening of symptoms.[13] Other interventionists, however, after the primary PCI , along with treating the patient with medications, will plan for revascularization of non-culprit artery(ies) with PCI within the next 60 days following the primary PCI, to minimize the risk of future MI.[12,13]

1.1. Literature review: complete versus culprit artery-only PCI

According to the American College of Cardiology/American Heart Association's (ACC/AHA) guideline for management of acute STEMI with MVD, if the patient with acute STEMI is hemodynamically stable, PCI should be considered only for the culprit artery at the index admission for MI; performing PCI in the non-culprit artery is not recommended at the time of primary PCI on the culprit artery.[9] Instead, PCI in a non-culprit artery should be conducted at a separate time from primary PCI, if noninvasive testing of the patient identifies that he/she is at immediate to high risk of subsequent MI.[3,9] However, there are variations in the literature regarding the clinical outcomes of PCI for significant stenosis in non-culprit arteries after successful primary PCI.[14]

Several systematic reviews and meta-analysis compared complete and culprit-only PCI in the past.[14–18] The study by Bangalore et *al*, for example, included 61,764 STEMI patients with MVD who underwent either complete or culprit artery-only PCI, and evaluated the early (≤30-day) and long-term major adverse cardiac events (MACE). No significant differences were found between the groups in regard to some early MACE such as MI, stroke, mortality, and target vessel revascularization.[15] However, in complete PCI group there was 44 % lower likelihood for repeat PCI in non-culprit arteries and 32% lower likelihood for overall major adverse cardiovascular events. When compared for long-term outcomes of MACE (follow-up 2.0 ± 1.1 years), there was decreased risk of mortality, repeat PCI, and CABG by 33%, 43%, and 53%, respectively, and 40% decreased overall long-term MACE in the complete PCI group compared to culprit artery-only PCI group.[15]

The meta-analysis by Bainey et *al*, which included 46,324 STEMI patients with MVD who underwent either complete or culprit artery-only PCI, evaluated hospital mortality and long-

term mortality outcomes. They found a 65% lower likelihood of hospital mortality in complete PCI compared to culprit artery-only PCI group, and a 26% lower likelihood of long-term mortality in complete PCI group compared to culprit artery-only PCI group.[16] The meta-analysis by Vlaar et *al*, which included 4 prospective and 14 retrospective studies involving 40,280 STEMI patients with MVD, showed that complete PCI was associated with lower short- and long-term mortality as compared with culprit artery-only PCI.[17] A more recent meta-analysis of randomized controlled trials (RCT) by Sethi et *al* compared complete revascularization during primary PCI to culprit artery-only PCI or staged complete PCI, and found no significant differences in terms of total mortality between primary complete PCI and culprit artery-only PCI. Yet, staged complete PCI was associated with 45% lower likelihood in total mortality compared to primary complete PCI.[17]

Another recent meta-analysis study by Sekercioglu et *al* that compared complete PCI and culprit artery-only PCI found that complete revascularization reduced the risk of repeat revascularization and non-fatal MI by 65% for each outcome, with no significant differences in all-cause and cardiac mortality between these groups.[18] However, after sensitivity analysis that considered the risk of bias in the included trials, authors reported higher confidence in the estimates of the risk of revascularization only. The meta-analysis study by Anil et *al* included 748 STEMI patients with MVD who underwent complete PCI or culprit artery-only PCI. When compared for outcomes such as cardiovascular death, repeat revascularization and non-fatal MI between these groups, it was shown that complete PCI was associated with decreased risk of cardiovascular death, repeat revascularization and non-fatal MI by 61%, 72%, and 62%, respectively compared to culprit artery-only PCI group.[19]

A study using the New York registry which included acute STEMI patients with MVD who underwent either complete PCI (n=632) or culprit artery PCI (n=1,350) evaluated for in-hospital clinical outcomes.[12] Results showed that in-hospital mortality was 0.8% versus 2.3% among complete versus culprit artery-only PCI.[12] There was no any difference in terms of ischemic complications, renal failure, or length of stay.[12] After multivariable analysis, in-hospital mortality remained a significant predictor; complete PCI reduced the likelihood of in-hospital mortality by 73%.[12] A prospective observational study by Hannan et *al* compared clinical outcomes among hemodynamically unstable STEMI patients with MVD who underwent culprit artery-only PCI or complete PCI.[21] Results showed that, in-hospital mortality was 0.8% versus 2.4% among culprit artery-only PCI versus complete PCI. When comparing the 12-month mortality, it was 1.3% versus 3.3% among complete PCI versus culprit artery-only PCI.[20] In summary, there are number of studies demonstrating that complete PCI is superior strategy to culprit artery-only PCI when treating STEMI patients with MVD. These studies however did not specifically address patients health related quality of life (QoL) and angina control. A more detailed review of literature is presented in Appendix A.

1.2. Situation in Armenia

Armenia is a country in Southwestern Asia with the population of about 3 million.[21] CAD is the leading cause of death in Armenia as in the most of the world.[22] According to 2014 WHO report on non-communicable diseases in Armenia, CAD is estimated to account for 54% of total mortality.[22] Armenia Health System Performance Assessment report by WHO identified CAD as the most prevalent cause of mortality, 54% and 49% in 2002 and 2008, respectively.[23]

1.3. Rationale for the study

Although current clinical practice guidelines do not recommend complete PCI, several studies indicated that complete PCI is superior strategy in comparison to culprit artery-only PCI in acute STEMI patients with MVD. Therefore, more research is needed to strengthen the evidence regarding acute STEMI management with MVD. There is also scarcity of research regarding patients' quality of life after complete versus culprit artery-only PCI.

The Nork Marash Medical Center (NMMC) is a leading tertiary cardiac center in Armenia which treats both pediatric and adult cardiac patients.[24] Approximately 400 patients undergo PCI each year at NMMC, accounting for more than one-third of all patients undergoing PCI in Armenia annually (an unofficial estimate). While there are ongoing debates about differences in outcomes between complete and culprit artery-only PCI, no studies have been conducted on this issue in Armenia.

1.4. Study aim and objectives

The aim of the study is to identify if complete PCI strategy during the index admission is superior in treating acute STEMI patients with MVD in comparison to culprit artery-only PCI strategy in the NMMC, Armenia.

<u>The primary objective of the study is:</u>

- To investigate whether the complete PCI during the index admission leads to reduced risk of major adverse cardiac events (MACE) (defined as a composite outcome of all-cause mortality, new MI or ischemia- driven repeat revascularization performed by PCI or

CABG) than the strategy of culprit artery-only PCI among acute STEMI patients with MVD treated in NMMC, at the time of follow-up.

The secondary objectives are:

- To investigate whether the complete PCI during the index admission leads to better angina control in comparison to culprit artery-only PCI among acute STEMI patients with MVD treated in NMMC, at the time of follow-up.
- To investigate whether the complete PCI during the index admission leads to better QoL compared to the strategy of culprit artery-only PCI among acute STEMI patients with MVD treated in NMMC, at the time of follow-up.

2. METHODS

2.1 Study design

The study utilized an observational, retrospective cohort design. The cohort included all acute STEMI patients with MVD who underwent complete or culprit-artery only PCI at NMMC from April 1, 2012 to March 31, 2014. Patients were followed up maximum three years and minimum one year since the index hospitalization for the primary PCI.

2.2. Study population

Population setting is Armenia. Target population included acute STEMI patients with MVD who underwent primary PCI and the study population was acute STEMI patients with MVD who underwent primary PCI from April 1, 2012 to March 31, 2014 at NMMC.

Inclusion Criteria

- The study enrolled all acute STEMI patients with MVD that had primary PCI at NMMC during the study period. Patients who received complete revascularization by PCI at the index admission were included in complete PCI group.[20,25]
- The culprit artery-only PCI group included patients who underwent PCI at the index admission for the culprit artery-only.[28] Non-culprit artery(ies) that needed revascularization was defined any coronary artery with >50% narrowing.[26]

Exclusion Criteria

- Prior CABG surgery or PCI.[19]
- 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

2.3. Sampling frame and sampling method

The NMMC PCI computerized dataset for the time period from April 1, 2012 to March 31, 2014 served as the sampling frame to select all patients (i.e., census) who meet the inclusion criteria. Census was chosen as a sampling method to maximize the study power and precision

since there was a chance of high loss to follow-up considering the experience from the past studies conducted in NMMC.

2.4 Study variables

- *The dependant variables are* MACE after the first year of PCI, angina control, and quality of life. MACE includes all-cause mortality, new MI and ischemia- driven repeat revascularization performed by a PCI or CABG.[27]
- *Independent variables are* culprit artery-only or complete PCI (the main variable of interest), and other potential predictors of MACE as age, gender, cardiac status, ejection fraction, troponin enzyme level, arrhythmia, body mass index (BMI), smoking status, family history of CAD, hypertension, hypercholesterolemia, chronic obstructive pulmonary disease , creatinine level, cerebrovascular disease, previous MIs, diabetes, ventricular arrhythmia, dialysis, anemia, number and type of the diseased vessels, stented vessels diameter, stent type, and lesion length (Appendix B).

2.5 Sources of data

NMMC PCI dataset was the source for retrieving patient contact information. A telephone interview was conducted for the evaluation of MACE, QoL, and angina control. In case of death, information about the cause of death and the date of death was asked from patient's family member. Information about the patients' perioperative characteristics was extracted retrospectively from the medical records.

2.6 Study instruments

Two instruments were used for this study. A telephone interviewer-administered structured questionnaire with two sections was used to collect data about patient quality of life measured by EQ-5D-5L [28,29]and MACE (Appendix B). The angina questions were adopted from Seattle angina questionnaire.[30,31] Data from medical records was extracted to Medical Record Data Abstraction Form (Appendix C) that included questions about demographic characteristics, cardiac status, CAD risk factors and comorbidities at admission and procedural characteristics. The medical chart abstraction form has been adopted from a past study evaluating sex differences in patients with PCI intervention in Armenia.[32] The name and contact information of the patients for telephone interviews were obtained from NMMC dataset and registered in the specially developed Journal form (Appendix D).

2.7 Ethical considerations

The research protocol was reviewed by the Institutional Review Board (IRB) within the School of Public health at the American University of Armenia and approved by the NMMC Administrative Board and. All eligible participants were included in the study only after giving an oral consent (Appendix E). Although the data collected from the medical records includes the information on patients' names and telephone numbers, these data were not entered into the computerized database; instead, coded patient identifiers were used. After data entry and cleaning, the paper forms (i.e., Journal Form) containing respondent identifiers were destroyed. At that point anonymity was assured. When the patient contacted was identified as deceased by the relative, other than the cause and date of death, no further questioning was attempted, and the call was ended after a condolence expressed.

2.8 Data collection and data entry

Data collection was conducted between March and April, 2015. Telephone interviews lasted for about 10 minutes. After the review of the medical records, patients were separated depending on the mentioned criteria into complete PCI and culprit artery-only PCI group, and perioperative data were extracted from their medical records. Data on angina control, compliance to the prescribed drugs, quality of life, lifestyle, and socio-demographic characteristics was collected through telephone interviews. All data was entered into SPSS 22 software package (SPSS Inc., Chicago IL) compatible data-file for the analysis. Single data entry was performed. Logic and range checks were used for data cleaning. Following cleaning, a de-identified dataset was produced for the subsequent analyses.

2.9 Statistical analysis

All statistical analyses were performed using Stata14 software package (StataCorp. 2015. Stata Statistical Software: Release12. College Station, TX: StataCorp LP). For descriptive analyses, continuous variables were presented as means and standard deviations and were compared by the Student t-test. Categorical variables were presented as counts and percentages and were compared using Chi-square test or Fisher's exact test. The Kaplan-Meier product-limit method was used to estimate the survival from MACE for each group. Multivariable Cox proportional hazards regression analysis was used to compare survival rates between complete and culprit artery-only PCI groups. Unadjusted comparisons were conducted for angina control and quality of life between the groups with complete PCI and culprit-only PCI using student t-test.

3. RESULTS

3.1. Administrative data

Overall, 900 patients underwent PCI from April 1, 2012 to March 31, 2014 at NMMC, of whom 346 patients with STEMI and MVD were identified as eligible.

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.

After data collection and cleaning, variables such as arrhythmia, history of CAD and anemia, had missing values exceeding 10% of the total sample size, and were subsequently excluded from the analyses. The variable representing cardiogenic shock status was inconsistently reported in the medical records and was also excluded from the analyses.

3.2. Demographic and baseline clinical characteristics

From 306 patients included in the sample for survival analyses, 150 (49.01%) underwent complete PCI strategy and 156 (50.99%) culprit artery-only PCI strategy. Among 306 patients included in the survival analysis 245 (80.06%) were men. Patients' baseline characteristics stratified by PCI procedural types are presented in Table 1. There were more females in the culprit artery-only PCI group than in the complete PCI group (26.93% versus 12.67%, p=0.001).

In terms of existing comorbidities, the complete PCI group was more likely to suffer from heart failure, cerebrovascular disease, gastrointestinal disease, COPD and diabetes. The average door to balloon time was significantly longer in the complete PCI group than in culprit artery-only PCI group ($p<0.001$). The patients in culprit artery-only PCI group were more likely to have past history of MI. The groups were similar with respect to smoking status, BMI, stable and unstable angina, left ventricular ejection fraction and type of stent used during the procedure.

Some angiographic characteristics also differed between the two PCI groups (Table1b). In terms of angiographic characteristics, proximal LAD artery involvement were more often in the culprit artery-only PCI group (35.06% versus 14.50%) compared to the complete PCI revascularization group ($p=0.15$). The total number of stents implanted per patient was significantly higher in complete PCI revascularization group (2.12 versus 1.12, $p <0.001$). None of the patients in either group had more than three vessels affected.

The groups did not differ significantly in the rates of discharge medication prescriptions (Table 1b).

3.3. Event-free survival rates at two year follow-up

The average follow-up time was 27.8 (SD=1.1) months for the full sample, 28.5 (SD=1.6) months for the complete PCI group and 26.8 (SD=1.1) months for the culprit artery-only PCI group ($p=0.039$). In total, 34 patients (11 in complete PCI and 23 in culprit artery-only group) developed 34 MACE during the follow up period including 8 patients with MI, 16 with repeat revascularization and 10 patients that died (Table 2). As the Kaplan-Meier curves show (Figure 1), the freedom from MACE at two year follow up was 67.02% in the complete PCI group, compared with 63.84% in the culprit artery-only PCI group ($p=0.039$).

3.4. Angina control after PCI

The unadjusted analysis of angina control score showed significantly better results for complete PCI group regarding walking indoors on level ground, lifting or moving heavy objects and frequency of chest pain, chest tightness or angina (Table 3). No differences were observed in gardening, vacuuming or carrying groceries ($p>0.05$). The mean angina score (possible range 0-16, with lower scores indicating better control) for the complete PCI group was 9.02 and the mean score for the culprit artery-only group was 9.65 ($p=0.0008$), indicating better angina control in the complete PCI group.

3.5. Quality of life after PCI

The unadjusted analysis of EQ-5D-5L score showed significantly worse results for complete PCI group regarding anxiety /depression (Table 4). No differences were observed in the domains of mobility, self-care, doing usual activities and pain/discomfort. The patients' overall health status estimated from the visual analogue scale also showed no significant differences between the complete and culprit artery-only groups 59.03(16.9) versus 60.0 (18.8), $p=0.549$). The unadjusted average EQ-5D utility score was higher for the complete PCI group compared to culprit artery-only PCI group (0.68 (SD=0.02) versus 0.59 (SD=0.02), $p=0.004$).

3.5. Cox proportional hazards model

The unadjusted predictors of one year survival (MACE) were identified using univariate Cox proportional hazard models (Table 5a). Significant predictors ($p<0.05$) were the number of three diseased vessels and hypertension.

The final model was developed first by selecting all variables with $p<0.05$ from the univariate analysis, and then using backward elimination by applying the log-likelihood ratio test. The proportional hazard assumption of the Cox model was tested for the final model.

The final model was adjusted for the three vessel disease in reference to two vessel disease and hypertension (Table 5b). After adjusting for these covariates, the hazard of developing MACE was 55% lower in the complete PCI group as compared to the culprit artery-only PCI group (HR=0.45, 95% CI: 0.22-0.95, p=0.032).

4. DISCUSSION

The study evaluated the differences in 2 –year event free survival from MACE in patients who underwent complete PCI and culprit artery-only PCI for MVD after STEMI during index admission between 2012 and 2014 at NMMC. A retrospective cohort study design was utilized for the study where patient baseline characteristics were abstracted from the medical records and post-procedural events established through patient surveys. The final sample included 306 patients of which 49.02% had complete PCI and 51.98% had culprit artery-only PCI.

We found that at index hospitalization for PCI, complete and culprit artery-only PCI patients had different baseline profiles. For example, patients in the complete PCI group had more males, had higher door-to-balloon time, and were more likely to suffer from heart failure than those in the culprit artery-only PCI group. These findings are consistent with many other many retrospective studies, but also conflicting with some randomized controlled trials.[34–38]

The current study results showed that patients in the complete PCI group had 55% lower MACE rate at the mean follow-up of 28 months compared to patients in culprit artery-only PCI

group. This finding agrees with the systematic reviews by Banglore et *al* and Pandit et *al*.[15,19] Furthermore, in the multivariable analysis we found that hypertension increased the hazard of developing MACE, which is inconsistent with the results of the study conducted by Kong et *al*, where hypertension was not reported as a significant predictor of MACE.[12] It came out that compared to having two diseased coronary vessels, having three diseased vessels increases the chance of MACE when controlling for the intervention type (complete/culprit) and hypertension, similar to findings in the literature.[33] Patients in the culprit artery-only PCI group had more number of three diseased vessels, as was found in a trial by Anthony et *al*.[39] A 65% reduction in MACE in complete PCI group compared to culprit artery-only PCI group became more debatable after the publication of PRAMI trial. [40] In the current analysis, the event-free survival at the end of the follow-up period was higher in the complete PCI group when compared to culprit artery-only PCI group. These results are in agreement with other studies, which showed that complete PCI yields to better event-free survival rate.[4,15,41]

However, Hannan et al. study showed that complete PCI leads to worse clinical outcomes. The reason for a trend toward increased mortality with complete PCI during index admission in the nonrandomized registry studies is likely attributable to case selection. It was also acknowledged by the authors of the study.[20]

A study conducted in Armenia at NMMC in 2011, which evaluated three year MACCE survival after PCI and enrolled 465 patients, showed diabetes status and sex strongly interact with MACCE. In non-diabetic population women have significantly better long-term survival than men, while the opposite was observed in diabetic population.[32] In the current study, diabetes was not a predictor in occurrence of MACE.

One of the possible limitations of the study was that the follow up data about MACE

was collected retrospectively trough the telephone interviews, which could create a recall bias. To minimize that bias we clarified from NMMC, if the patient was re-hospitalized and treated there. Another source of potential bias came from the inaccuracies in medical records that, for example, did not consistently report troponin level and creatinine level. The sample represents responders from a single center, the NMMC, indicating that patients who underwent PCI in 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.

Conclusions and recommendations

The current study assessed the difference in 2-year event-free survival among patients with MVD and STEMI who had undergone either complete or culprit artery-only PCI. The hazard of developing MACE was significantly reduced in complete PCI group. Three-vessel disease (compared to two-vessel disease) and hypertension were independent predictors of MACE. Considering the results and the fact that both of the PCI types are still in use, more studies are needed to show the advantages and disadvantages of each type for specific patient populations.

In unadjusted analysis, angina control was significantly improved in the complete PCI group compared to culprit only-PCI group treated on index admission. In unadjusted analysis, no significant difference was observed between the groups in QoL by visual analogue scale, while the QoL measured by Health Utility Index was significantly better in culprit artery-only PCI group.

In the future, the STEMI guideline committees may consider this study results when developing recommendations on treating significant non-culprit artery stenosis in patients with STEMI and MVD undergoing primary PCI. Studies with larger sample size and multi-centered studies are needed to achieve better accuracy and generalizability.

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Tables 1a. Patient baseline characteristics

Characteristics	Complete revascularization n=150	Culprit artery-only revascularization n=156	*P* value
Demographic characteristics			
Gender, n (%)			
Male	131 (87.3)	114 (73.0)	0.001
Female	19 (12.7)	42 (26.9)	
Age (years), mean (SD)	64.6 (5.28)	64.1(5.45)	0.474
Currently working, n (%)			
Yes	88 (59.9)	91(58.3)	0.652
No	59 (41.3)	58 (41.7)	
Risk factors and comorbidities			
BMI (kg/m^2), mean(SD)	28.9 (5.55)	28.7 (5.50)	0.505
Smoking status at PCI, n (%)			
Yes	22 (15.0)	21 (16.6)	0.723
No	124 (84.9)	133 (86.4)	
Diabetes, n (%)			
Yes	39 (26.7)	36 (23.3)	0.723
No	107 (73.28)	118 (76.63	
Hyperlipidemia, n (%)			
Yes	30 (0.3)	36 (23.2)	0.575
No	60 (0.6)	119 (76.7)	
Hypertension, n (%)			
Yes	110 (75.3)	111 (71.6)	0.505
No	36 (24.6)	44 (28.4)	
Heart failure, n (%)			
Yes	19 (13.5)	3 (1.9)	<0.001
No	122 (86.5)	152 (98.0)	
Creatinine level (µmol/ L), mean (SD)	87 (18.49)	87(21.80)	0.714
Cerebrovascular disease, n (%)			
Yes	6 (0.4)	3 (0.1)	0.268
No	140 (99.5)	152 (99.9)	
GI disease, n (%)			
Yes	19 (13.0)	24 (15.5)	0.540
No	127 (87.0)	131 (84.5)	
COPD, n (%)			
Yes	4 (2.8)	2 (1.3)	0.373
No	141(97.2)	151 (98.7)	
Cardiac status			
Stable angina, n (%)			
Yes	28 (19.2)	30 (19.4)	0.780
No	118 (80.8)	125 (80.6)	
Unstable angina, n (%)			
Yes	109 (74.7)	108 (69.7)	0.336

No	37 (23.3)	47 (30.3)	
History of MI, n (%)			
Yes	54 (37.0)	57 (36.8)	0.970
No	92 (63.0)	98 (63.2)	
MI status by Troponin level, n (%)			
Probable MI	79 (52.8)	98 (62.8)	0.072
Normal	71 (47.2)	58 (37.2)	
LVEF (%), mean (SD)	45.5 (3.91)	46.0 (4.05)	0.232

BMI: body mass index; PCI: percutaneous coronary intervention; GI: gastrointestinal; COPD: chronic obstructive pulmonary disease; MI: myocardial infarction; LVEF: left ventricular ejection fraction.

Table 1b. Angiographic characteristics of coronary arteries

Characteristics	Complete revascularization n=150	Culprit artery-only revascularization n=156	*P* value
Number of diseased vessels, n (%)			
Two	115(76.7)	116 (74.4)	0.639
Three	35 (23.3)	40 (25.6)	
Door to balloon time (min), mean (± SD)	192 (45.2)	163 (30.8)	<0.001
Stent approach, n (%)			
Radial	113 (75.3)	113 (72.4)	0.564
Femoral	37 (24.7)	43 (27.6)	
PCI treated culprit arteries, n (%)			
Proximal RCA	28 (18.7)	25 (15.0)	0.542
Mild RCA*	22 (14.7)	16 (10.2)	0.242
LMS	0 (0)	0 (0)	-
Proximal LAD	27(18.0)	29 (18.6)	0.609
Mild LAD	21 (14.0)	14 (9.0)	0.155
Proximal circumflex	9 (6.0)	14 (9.0)	0.324
Other arteries	18 (12.0)	26 (16.7)	0.245
PCI treated non-culprit arteries, n (%)			
Proximal RCA	24(12.4)	28(18.2)	0.650
Mild RCA*	43(22.3)	19(12.3)	0.001
LMS	1(0.5)	2(1.3)	0.585
Proximal LAD	28 (14.5)	54(35.1)	0.005
Mild LAD	46 (23.8)	36 (23.4)	0.215
Proximal circumflex	30(21.6)	1(0.7)	<0.001
Other arteries	21 (4.7)	14 (8.1)	0.167
Number of stents placed, mean (SD)	2.12(0.5)	1.12(0.4)	<0.001
Discharge medication, n (%)			
Antiplatelets	136 (90.7)	152 (97.4)	0.863
BBs	92 (61.3)	96 (64.0)	0.847
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

**Stenosis <70%.*

PCI: percutaneous coronary intervention; RCA: right coronary artery; LMs: left main stem coronary artery; LAD: left anterior descending; ACE: angiotensin-converting enzyme;

Table 2. Distribution of major cardiac events between complete and culprit artery-only PCI

Events	**Complete revascularization n=150** n events (%), n patients	**Culprit artery-only revascularization n=156** n events (%), n patients	***P* value**
MI	3(2.00) (3)	5(3.20) (5)	0.333
RR			
Stenting	4 (2.67) (4)	9(5.77) (9)	0.369
CABG	1(0.67) (1)	3(1.92) (3)	0.223
Death	3 (2.00) (3)	7(4.48) (7)	0.221
Total MACE	11 (7.33)	23 (14.74)	0.039

CABG: coronary artery bypass graft; MACE: Major Adverse Cardiac events; MI: Myocardial infarction; RR: Repeat Revascularization

Table 3. Angina control at the time of follow-up interview

Domains and items	Complete Revascularization n = 139	Culprit artery-only Revascularization n = 133	*P* value
Walking indoors on level ground			
Extremely limited	9 (6.5)	33 (24.8)	
Moderately limited	85 (61.2)	69 (51.9)	<0.001
Slightly limited	52 (37.4)	39 (29.3)	
Not at all limited	0 (0.00)	2 (1.50)	
Limited for other reasons/did not do the activity	1 (0.7)	4 (3.0)	
Gardening, vacuuming or carrying groceries			
Extremely limited	18 (12.9)	18 (13.5)	0.154
Moderately limited	75 (54.0)	76 (57.1)	
Slightly limited	47 (33.8)	50 (37.6)	
Not at all limited	5 (3.6)	2 (1.5)	
Limited for other reasons/did not do the activity	2 (1.4)	1 (0.8)	
Lifting or moving heavy objects			
Extremely limited	38 (27.3)	73 (54.9)	<0.001
Moderately limited	108 (7.7)	68 (51.1)	
Slightly limited	1 (0.72)	2 (1.5)	
Not at all limited	0 (0.0)	3 (2.3)	
Limited for other reasons/did not do the activity	0 (0.0)	3 (2.3)	
Chest pain, chest tightness or angina			
4 or more times per day	4 (2.9)	7 (5.3)	0.006
1-3 times per day	40 (28.8)	56 (42.1)	
3 or more times per week but not every day	99 (71.2)	71 (53.4)	
1-2 times per week	4 (2.9)	8 (6.0)	
Less than once a week	0 (0.0)	5 (3.8)	
None over the past four weeks	0 (0.0)	2 (1.5)	
Summative angina score, mean (SD)	9.02 (1.38)	9.65 (1.73)	0.0008

Table 4. Quality of life at the time of follow-up interview

EQ-5D Domains and items	Complete Revascularization n = 139	Culprit artery-only Revascularization n = 133	*P* value
Mobility/Walking about			
No problems	55 (39.6)	55 (41.4)	0.993
Slight Problems	23 (16.5)	26 (19.5)	
Moderate Problems	51 (36.7)	49 (36.8)	
Severe Problems	16 (11.5)	17 (12.8)	
Unable to do	2 (1.4)	2 (1.5)	
Self-care/washing or dressing yourself			
No problems	92 (66.2)	105 (79.0)	0.213
Slight Problems	28 (20.1)	27 (20.3)	
Moderate Problems	23 (16.5)	12 (9.0)	
Severe Problems	3 (2.2)	5 (3.8)	
Unable to do	1 (0.7)	0 (0.0)	
Doing usual activities			
No problems	59 (42.4)	54 (40.6)	0.097
Slight Problems	34 (24.5)	32 (24.0)	
Moderate Problems	39 (28.1)	49 (36.8)	
Severe Problems	6 (4.3)	12 (9.0)	
Unable to do	9 (6.5)	2 (1.5)	
Pain/discomfort			
No problems	46 (33.1)	47 (35.3)	0.854
Slight Problems	22 (15.8)	27 (20.3)	
Moderate Problems	50 (36.0)	50 (37.6)	
Severe Problems	28 (20.1)	23 (17.3)	
Unable to do	2 (1.4)	1 (0.8)	
Anxiety/depression			
No problems	68 (48.9)	67 (50.4)	0.021
Slight Problems	24 (17.3)	44 (33.1)	
Moderate Problems	39 (28.0)	30 (22.6)	
Severe Problems	16 (11.5)	7 (5.3)	
Unable to do	0(0.00)	1 (0.8)	
Current health status, mean VAS (SD)	59.03 (16.9)	60.00 (18.8)	0.549
QOL health utility score, mean (SD)	0.68 (0.02)	0.54 (0.02)	0.004

Table 5a. Univariable survival analyses for MACE

Variables	Hazard ratio	*P* value	(95% CI)
Complete PCI (*reference*: culprit artery-only PCI)	0.47	0.044	(0.23-0.98)
Female (*reference*: male)	1.79	0.273	(0.62-5.14)
Age less than 65 years (*reference*: age ≥65)	1.01	0.841	(0.87-1.17)
Two vessel disease (*reference*: three vessel disease)	2.08	0.041	(1.03-4.19)
Diabetes	0.66	0.343	(0.28-1.54)
Hypercholesterolemia	0.77	0.579	(0.32-1.88)
Hypertension	2.39	0.075	(0.91-6.25)
Congestive heart failure	1.27	0.688	(0.38-4.17)
Previous history of MI	0.75	0.443	(0.36-1.54)

LAD: left anterior descending; MI: myocardial infarction;

Table 5b. Multivariable Cox proportional hazards model for MACE

Variables	**Hazard Ratio**	***P value***	**(95% CI)**
Complete PCI (*reference*: culprit artery-only PCI)	0.45	0.032	(0.21 - 0.93)
Three vessel disease (*reference*: two vessel disease)	2.31	0.019	(1.14 - 4.65)
Hypertension	3.11	0.026	(1.14 - 8.51)

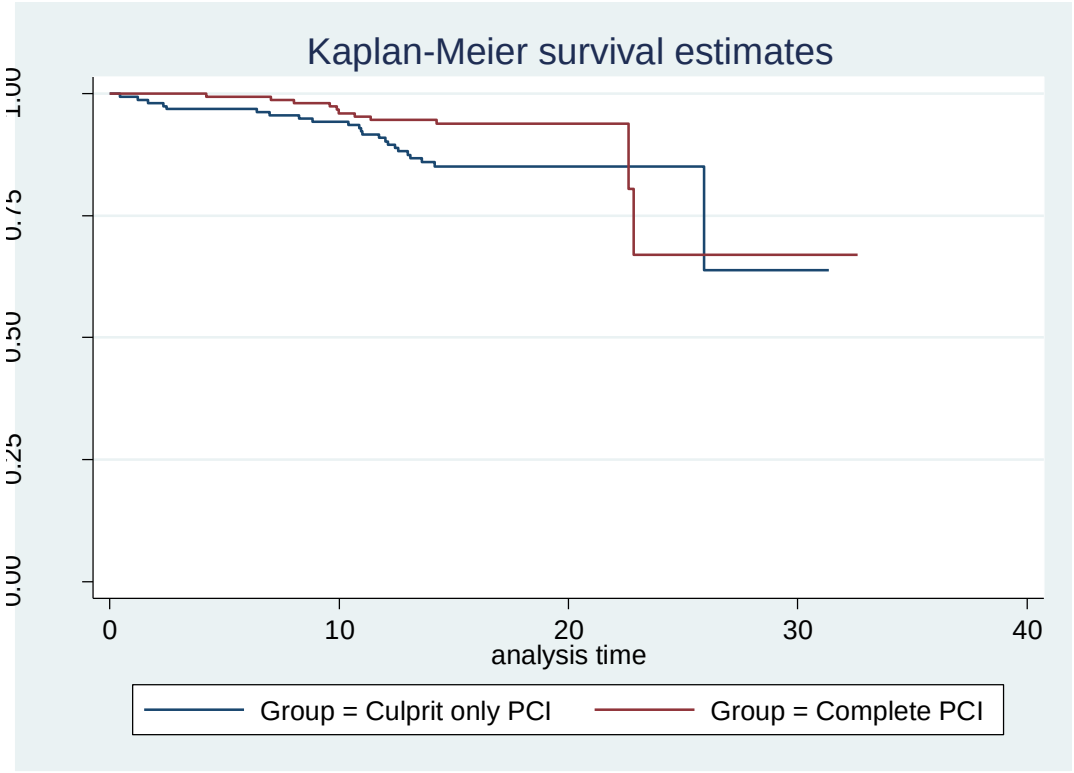

Figure 1. Event-free survival from MACE by complete revascularization

Test Statistics for Equality of Survival Distributions for GROUPS

	Statistic	df	Significance
Log Rank	4.24	1	.0394

Appendices

Appendix A. Review of literature

Author, Results Year, Country	Study type	Details	
Sethi et al, 2014, USA.	Meta-analysis	Target population: STEMI patients with MVD. Intervention: Primary complete PCI or Culprit artery-only PCI or staged PCI Primary end points: Total mortality.	Primary end-points: Total mortality. Primary complete vs. culprit artery-only PCI 0.67, 95% CI: 0.37 to 1.22 Primary complete PCI vs. staged PCI: 1.55, 95% CI: 0.42 to 5.78
Sekercioglu et al, 2014, Canada.	Meta-analysis	Target population: STEMI patients with MVD. Intervention: Complete PCI or Culprit artery- only PCI. Primary end points: MI, revascularization, cardiovascular mortality, all-cause mortality	Primary end points: MI, revascularization, cardiovascular mortality, all-cause mortality. Complete vs. culprit artery-only PCI MI: RR: 0.35, 95% CI: 0.17-0.72, Revascularization: RR: 0.35, 95% CI: 0.24-0.53, cardiovascular mortality: RR: 0.69, 95% CI: 0.40-1.21, all-cause mortality: RR: 0.48, 95% CI: 0.22-1.04

Pandit et al, 2014, USA.	Meta-analysis	Target population: STEMI patients with MVD. Intervention: Complete PCI or Culprit artery- only PCI. Primary end points: MACE which includes death, repeat revascularization and non-fatal myocardial infarction or refractory angina	Primary end-points: Complete vs. culprit artery-only PCI Death: pooled OR 0.39, 95% CI 0.18 to 0.83, p=0.01, I^2=0%, repeat revascularization: pooled OR 0.28, 95% CI 0.18 to 0.44, p=0.00001, I^2=0%, non-fatal myocardial infarction: pooled OR 0.38, 95% CI 0.20 to 0.75, p=0.005, I^2=0%
Bainey et al, Canada, 2014.	Meta-analysis	Target population: STEMI patients with MVD. n=46,324. Intervention: Complete PCI or Culprit artery-only PCI. Primary end points: Short term (in-hospital or 30 day) mortality.	Primary end points: Short term (in-hospital or 30 day) mortality. Complete vs. culprit artery-only PCI Short term mortality: OR 1.11, 95% CI 0.98-1.25, P = .10 vs. OR 0.24, 95% CI 0.06-0.91, P = .04
Chen et al[44], 2014, China	Meta-analysis	Target population: STEMI patients with MVD. Intervention: Complete PCI or Culprit artery-only PCI. Primary end points: Short-and long- term mortality, renal failure.	Primary end-points: Short term long term mortality, renal failure. Complete vs. culprit artery-only PCI Short term mortality: OR = 1.39, 95% CI = 1.26, 1.53, long term mortality: OR = 1.35, 95% CI = 1.09, 1.67, Renal failure: OR = 0.45, 95% CI = 0.27, 0.74.

Vlaar et al, 2011, The Netherlands	Meta-analysis	Target population: Patients with STEMI MVD. Intervention: Complete PCI or Culprit artery only PCI. Primary end points: Short term (in-hospital or 30 day) mortality.	Primary end-points: Short-term mortality was associated With Complete vs. culprit artery-only.PCI Complete PCI: OR: 3.03, 95% CI: 1.41 to 6.51, p = 0.005 Culprit: OR: 0.66, 95% CI: 0.48 to 0.89, p = 0.007
Politi et al, 2013, Italy	Randomized controlled trial	Target population: STEMI patients with MVD. n=46,324. Intervention: Complete PCI or Culprit artery-only PCI. Primary end points: MACE which includes death, repeat revascularization and non-fatal myocardial infarction or refractory angina	Primary end points: MACE which includes death, repeat revascularization and non-fatal myocardial infarction. Complete vs. culprit artery-only PCI MACE: 50% vs.23.1% p<0.001.
Hannan at al, 2013, USA.	Observational : Retrospective cohort New York registry	Target population: STEMI patients with MVD. Intervention: Complete PCI or Culprit artery-only PCI. Primary end points: In-hospital mortality, 12-month mortality rate	Primary end points: In-hospital mortality, 12-month mortality rate. Complete vs. culprit artery-only PCI In-hospital mortality: 2.4% vs. 0.9%, p = 0.04 12-month mortality rate: 1.3% vs. 3.3%, p = 0.04.
Cavender et al[41], 2009, USA.	Observational : National Cardiovascular Data Registry	Target population: STEMI patients with MVD n=708,481 Intervention: Complete PCI or Culprit artery-only PCI. Primary end points: In-hospital mortality, 12-month mortality rate	Primary end points: In-hospital mortality, 12-month mortality rate. Complete vs. culprit artery-only PCI In-hospital mortality 7.9% vs. 5.1%, p <0.01

Wald et al[34], 2013, UK.	PRAMI study	Target population: STEMI patients with MVD n=465. Intervention: Complete PCI or Culprit artery-only PCI. Primary end points: MACE that includes death, non-fatal myocardial infarction, and refractory angina	Primary end-points: MACE which includes death, non-fatal myocardial infarction and Refractory angina. Complete vs. culprit artery- only PCI.HR are Cardiac death: 0.34,95% CI, 0.11 to 1.08 non-fatal myocardial infarction: 0.32 95% CI, 0.13 to 0.75 Refractory angina: 0.35 95% CI, 0.18 to 0.69.
Toma et al[37], 2013, Canada.	APEX: AMI trial	Target population: STEMI patients with MVD n=2201. Intervention: Complete PCI or Culprit artery-only PCI. Primary end points: 90 mortality rate	Primary end-points: 90 mortality rate. Complete vs. culprit artery-only PCI. Increased mortality rate associated with complete PCI hazard ratio 2.44, 95% CI 1.55-3.83, P < 0.001
Banglore et al., 2011, USA.	Meta-analysis study	Target population: STEMI patients With MVD. Intervention: Complete PCI or Culprit artery-only PCI. Primary end points: MACE that includes death, non-fatal myocardial infarction, and refractory angina	Primary end points: MACE is 44% less reported in the complete group compared to culprit artery-only PCI. MACE: odds ratio 0.60,95% CI 0.50 to 0.72.

Aaron et al., 2007, USA.	Observational : Retrospective, prospective study (MEDPAR)	Target population: STEMI patients with MVD n =24,106 Intervention: Complete PCI or Culprit artery-only PCI. Primary end points: Vascular complication and acute renal failure.	Primary end points: Vascular complication and acute renal failure. Complete vs. culprit artery -only PCI. Vascular complication: 5.4% vs. 5.7% p<0.005 Acute renal failure:8.8 % vs. 6.8% p<0.005
Kornowski et al[45], 2011, Israel.	HORIZONS-AMI study	Target population: STEMI patients With MVD. Intervention: Complete PCI or Culprit artery-only PCI. Primary end points: 1-year mortality and MACE, which includes cardiac mortality and definite/probable stent thrombosis.	Primary end points: 1-year mortality and MACE. Complete vs. culprit artery-only PCI. 1-year mortality: 2.3% vs. 9.2%; HR: 4.1, 95% CI: 1.93 to 8.86, p < 0.0001. MACE: 18.1% vs. 13.4%; HR: 1.42, 95% CI: 0.96 to 2.1, p =0.08

STEMI – ST-elevation myocardial infarction, MVD-Multivessel disease, CI – confidence interval, OR – odds ratio, HR –hazard ratio, MACE – major adverse cardiac events, PRAMI trial- Preventive Angioplasty in Acute Myocardial Infarction trial, APEX:AMI trial-Assessment of Pexelizumab in Acute Myocardial Infarction Trial, MEDPAR- Medicare Inpatient Hospital Payments, HORIZONS-AMI- Harmonizing Outcomes with Revascularization and Stents in Acute Myocardial Infarction.

Appendix B. Dependent and independent study variables

Variable	**Type**	Measure	**Source**
Dependent			
MACE	Binary	1=Yes 0= No	Telephone interview Medical records
LOS	Numeric (continuous)	*Days*	Medical records
Quality of Life	Ordinal	1= No problems 2= Slight problems 3= Moderate problems 4= Severe problems 5=Unable to do	Telephone interview
Mobility (Walking about)	Ordinal	1= No problems 2= Slight problems 3= Moderate problems 4= Severe problems 5=Unable to do	Telephone interview
Self-care (Washing or dressing yourself)	Ordinal	1= No problems 2= Slight problems 3= Moderate problems 4= Severe problems 5=Unable to do	Telephone interview
Doing your usual activities (e.g. work, etc)	Ordinal	1= No problems 2= Slight problems 3= Moderate problems 4= Severe problems 5=Unable to do	Telephone interview
Pain/discomfort	*Ordinal*	0= None 1= Slight 2= Moderate 3= Severe	Telephone interview
Anxiety/ Depression	*Ordinal*	0= None 1= Slight 2= Moderate 3= Severe	Telephone interview
Health status	*Continuous*	*1= Bad* *100= Good*	Telephone interview

Independent			
Age	Numeric (continuous)	Years	Medical record
Sex	Binary	1=Men 0=Women	Medical record
BMI	Numeric (Continuous)	Kg/m^2	Medical record
EF	Numeric (Continuous)	%	Medical record
Smoking status at the time of intervention	Binary	1=Yes 0= No	Medical record
Stable angina	Binary	1=Yes 0= No	Medical record
Unstable angina	Binary	1=Yes 0= No	Medical record
Previous MI	Binary	1=Yes 0= No	Medical record
Arrhythmia	Binary	1=Yes 0= No	Medical record
Hypertension	Binary	1=Yes 0= No	Medical record
Diabetes	Binary	1=Yes 0= No	Medical record
Previous PCI/CABG	Binary	1=Yes 0= No	Medical record
Number of diseased vessel	Nominal	1=Single 2=Double 3=Triple	Medical record
Number of stents placed	Nominal	1=Single 2=Double 3=Triple	Medical record
Stent Type	Nominal	0=BMS 1= DES 2 = Both	Medical record
LAD	Binary	1=Yes 0= No	Medical record
RCA	Binary	1=Yes 0= No	Medical record

LCX	Binary	1=Yes 0= No	Medical record
Aspirin	Binary	1=Yes 0= No	Medical record
Tienopiridine derivatives	Binary	1=Yes 0= No	Medical record
ACE inhibitors	Binary	1=Yes 0= No	Medical record
Beta blockers	Binary	1=Yes 0= No	Medical record
Statins	Binary	1=Yes 0= No	Medical record
SES (total monthly income of household)	Ordinal	1= <50,000AMD 2=51,000– 100.000 3=101.000-250.000 4=>250.000AMD	Telephone interview

Appendix C. Patient Questionnaire *(English version)*

Patient Questionnaire

Patient related Quality of Life

Questionnaire #_____ ID#_____Start time of the interview (hours/minutes)_____

Day of the interview (day/month/year) _____End time of the interview (hours/minutes) _____

Describing your health today

Dear _____ first I am going to ask you few questions about your health.

Under each heading, please indicate whether you have any problems with conducting the following daily activities by choosing the response that best describes your health today.

#		No problems	Slight problems	Moderate problems	Severe problems	Unable to do
1.	**Mobility** (Walking about)	□ 0	□ 1	□ 2	□ 3	□ 4
2.	**Self-care** (Washing or dressing yourself)	□ 0	□ 1	□ 2	□ 3	□ 4
3.	**Doing your usual activities** (e.g. work, study, housework, family or leisure activities)	□ 0	□ 1	□ 2	□ 3	□ 4

Please, indicate how you feel regarding the following concerns.

#		None	Slight	Moderate	Severe	Extreme
4.	**Pain/discomfort**	□ 0	□ 1	□ 2	□ 3	□ 4
5.	**Anxiety/ Depression**	□ 0	□ 1	□ 2	□ 3	□ 4

Now, we would like to know how good or bad your health is TODAY

6. Please imagine a thermometer that is marked from 0 to 100, where 100 is the best state you can imagine and 0 is the worst state you can imagine. **What number would indicate how good or bad is your health today?** _____

Now, we would like to ask how you feel and how things have been after you underwent PCI.

7. **Are the results from your heart PCI operation:**
Worse than you expected ☐
About what you expected ☐
Better than you expected ☐

8. **Are you currently smoking?**
No ☐ Yes ☐
If yes, how many cigarettes per day and for how long time.
1. <10cig/day ☐ 2.11-20cig/day ☐
3. 21-30cig/day ☐ 4. >30cig/day ☐
_____Years

<table>
<tr><td>9.</td><td colspan="3">During the last seven days, on how many days did you walk for at least 10 minutes at a time?
Days per week ____
Don't Know/Not Sure ☐</td></tr>
<tr><td>10.</td><td colspan="3">How much time did you usually spend walking on one of those days?
Hours per day __ __
Minutes per day __ __ __
Don’t Know/Not Sure ☐</td></tr>
<tr><td rowspan="5">11.</td><td colspan="3">We want to know if after the operation at the NMMC till now you had ANY hospital admissions for:</td></tr>
<tr><td>Reason(s)</td><td>Date(s) (dd/mm/yy)</td><td>Hospital</td></tr>
<tr><td>a. New MI No ☐ Yes ☐</td><td></td><td></td></tr>
<tr><td>b. Repeat PCI No ☐ Yes ☐</td><td></td><td></td></tr>
<tr><td>c. Stroke No ☐ Yes ☐</td><td></td><td></td></tr>
<tr><td>d. Other reason(s) No ☐ Yes
Specify_____</td><td></td><td></td></tr>
<tr><td>12.</td><td colspan="3">After your intervention have you been prescribed Clopidogrel (PLAVIX) by your doctor?
0. NO ☐ 1. YES ☐, if yes ☐ Q#13a</td></tr>
<tr><td>13.</td><td colspan="3">13a. For how long?
1.0-3 months ☐ 3. 6-9 months ☐
2.3-6 months ☐ 4. 9-12 months☐
13b. How long did you actually administer Clopidogrel?
1. 0-3 months☐ 3. 6-9 months ☐
2. 3-6 months☐ 4. 9-12 months ☐</td></tr>
</table>

14.	**Angina control**					
	Please, indicate whether you have any problems due to **chest pain, chest tightness or angina** with conducting the following daily activities by choosing the most suitable response option for each of these activities over the past 4 weeks.					
	Activity	**Extremely limited**	**Moderately Limited**	**Slightly limited**	**Not at all limited**	**Limited for other reasons or did not do the activity**
	14a.Walking indoors on level Ground	1□	2□	3□	4□	5□
	14b.Gardening, vacuuming or carrying groceries	1□	2□	3□	4□	5□
	14c.Lifting or moving heavy objects (e.g. furniture, children)	1□	2□	3□	4□	5□

15.	Over the past four weeks, on average, how many times have you had chest pain, chest tightness or angina?	4 or more times per day 1☐	1-3 times per day 2☐	3 or more times per week but not every day 3☐	1-2 times per week 4☐	Less than once a week 5☐	None over the past four weeks 6☐
16.	**Are you currently working?** No ☐ Yes ☐						
17.	**From the following categories which one best describes your household total monthly income in 2013?** 1. < 50,000 AMD ☐ 2. 51,000 – 100,000 AMD ☐ 3. 101,000 -250,000 AMD ☐ 4. > 250,000 AMD ☐ 5. Don't know ☐						

Appendix D. Patient Questionnaire ***(Armenian version)***

Հարցաթերթիկ առողջության վերաբերյալ	
Հարցաթերթիկ#_____ ՏՀ#_____ (ժամ/րոպե)_____	Հարցման սկիզբը
Հարցման ամսաթիվը (օր/ամիս/տարի) _____	Հարցման ավարտը (ժամ/րոպե) _____
Ձեր առողջության նկարագրությունը ներկայումս.	
Հարգելի_____, նախ, ես մի քանի հարց կտամ Ձեր առողջության մասին:	

1. Խնդրում ենք նշել, թե հետևյալ առօրյա գործողությունները կատարելու հետ կապված ի՞նչ աստիճանի դժվարություններ ունեք Դուք.						
#		**Ոչ մի դժվա-րություն**	**Թեթև դժվա-րություն**	**Միջին դժվա-րություն**	**Մեծ դժվա-րություն**	**Ի վիճակի չեմ կատարել**
1	Քայլել	□ 0	□ 1	□ 2	□ 3	□ 4
2	Լվացվել կամ հագնվել	□ 0	□ 1	□ 2	□ 3	□ 4
3	Կատարել առօրյա գործեր (աշխատանքի, ուսման, տան կամ ժամանցի հետ կապված)	□ 0	□ 1	□ 2	□ 3	□ 4
Նշեք, խնդրեմ, վերջին 30 օրվա ընթացքում Դուք ի՞նչ չափով եք զգացել.						
#		**Ոչ մի**	**Թեթև**	**Միջին**	**Ուժեղ**	**Ծայրահեղ**
4	Ցավ կամ անհարմարավետություն	□ 0	□ 1	□ 2	□ 3	□ 4
5	Տագնապ կամ ընկճվածություն	□ 0	□ 1	□ 2	□ 3	□ 4

Այժմ, մենք կցանկանայինք իմանալ, թե որքան լավ կամ վատ է Ձեր առողջական վիճակն ԱՅՍՕՐ:	
6.	Խնդրում եմ պատկերացրեք ջերմաչափ՝ համարակալված 0-ից մինչև 100-ը, որտեղ 100-ը նշանակում է լավագույն առողջական վիճակը, որ Դուք կարող եք պատկերացնել, իսկ 0-ն նշանակում է վատագույն առողջական վիճակը, որ Դուք կարող եք պատկերացնել: **Ո՞ր թիվն այդ ջերմաչափի վրա ամենաճիշտը կբնութագրեր Ձեր առողջական վիճակն այսօր:** _____
Այժմ, մենք կցանկանայինք հարցնել, թե ինչպես եք Ձեզ զգում վիրահատությունից հետո:	
7.	Ձեր սրտի վիրահատությունից հետո ստացված արդյունքը. ☐ Ձեր սպասածից ավելի վատ էր ☐ Գրեթե այն էր, ինչ Դուք սպասում էիք ☐ Ձեր սպասածից ավելի լավ էր
8.	Դուք ծխու՞մ եք ներկայումս: ☐ Ոչ ☐ Այո 8.1 եթե այո, խնդրում եմ նշեք, թե օրական քանի գլանակ եք ծխում . ☐ 1. 10 գլանակից քիչ ☐ 2. 11-20 գլանակ ☐ 3. 21-30 գլանակ ☐ 4. 30 գլանակից շատ 8.2 Որքա՞ն ժամանակ է՝ ինչ ծխում եք: _____տարի
9.	Վերջին 7 օրում, քանի՞ օր է եղել, երբ առնվազն 10 րոպե շարունակ քայլել եք: _____ օր շաբաթվա ընթացքում ☐ Չգիտեմ/Վստահ չեմ
10.	Այն օրերին, երբ քայլել եք, օրվա ընթացքում միջինում որքա՞ն ժամանակ եք ծախսել քայլելու վրա: _____ ժամ օրական _____ րոպե օրական ☐ Չգիտեմ/Վստահ չեմ

11. Նորք Մարաշ Բժշկական Կենտրոնում Ձեր ստենտավորումից հետո մեկ տարվա ընթացքում Դուք դարձյալ հոսպիտալացվե՞լ եք:
☐ Ոչ
☐ Այո – Եթե այո, խնդրում եմ նշեք հոսպիտալացման պատճառն ու մոտավոր ամսաթիվը:

Պատճառ(ներ)	**Ամսաթիվ (օր/ամիս/տարի)**	**Հիվանդանոցի անունը**
Նոր սրտամկանի ինֆարկտ		
Վերաստենտավորում		
Ինսուլտ		
Այլ պատճառ(ներ). Նշեք_____		

12. Ձեր ստենատավորումից հետո բժիշկը նշանակե՞լ է Ձեզ Կլոպիդոգրել՝ <<Պլավիկս>>:
☐ 0. Ոչ→ Անցեք հարց 14 ☐ 1.Այո

13. 13.a Ի՞նչ տևողությամբ այն.
☐ 1. 0-3 ամիս ☐ 3. 6-9 ամիս
☐ 2. 3-6 ամիս ☐ 4. 9-12 ամիս

13.b Որքա՞ն ժամանակ եք իրականում ընդունել
☐ 1. 0-3 ամիս ☐ 3. 6-9 ամիս
☐ 2. 3-6 ամիս ☐ 4. 9-12 ամիս

14. **Ստենոկարդիայի (կրծքային հեղձուկի) կարգավորումը**

Խնդրում եմ նշեք, թե վերջին 4 շաբաթվա ընթացքում կրծքավանդակի շրջանի ցավը, սեղմվելը կամ հեղձուկը (շնչարգելությունը) խանգարե՞լ են Ձեզ կատարել հետևյալ առօրյա գործողությունները:
Ընտրեք առավել համապատասխան տարբերակ յուրաքանչյուր գործողության համար:

Գործողություն	Շատ է խանգարել	Միջին չափով է խանգարել	Քիչ է խանգարել	Ամենևին չի խանգարել	Խանգարել են այլ պատճառներ կամ չեմ կատարել այդ գործողությունը

	14a. Տանը հարթ հատակին քայլել	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	
	14b. Պարտեզում աշխատել, փոշեկուլով տունը մաքրել կամ առօրյա գնումներ կատարել	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	
	14c. Ծանր իրեր բարձրացնել կամ տեղաշարժել (օր.՝ կահույք)	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	
	15. Վերջին 4 շաբաթվա ընթացքում Դուք քանի՞ անգամ եք զգացել կրծքավանդակում ցավ, ծանրություն կամ հեղձուկ (շնչարգելություն):	☐ 1. Օրական 4 կամ ավելի անգամ	☐ 2. Օրական 1-3 անգամ	☐3. Շաբաթը 3 կամ ավելի անգամ, բայց ոչ ամեն օր	☐ 4. Շաբաթը 1-2 անգամ	☐ 5. Շաբաթը 1անգա-միցքիչ	☐ 6. Ոչ մի անգամ վերջին 4 շաբաթվա ընթացքում
16.	**Դուք աշխատո՞ւմ եք ներկայումս:** ☐ Ոչ ☐ Այո						
17.	**Միջինում որքա՞ն է եղել Ձեր ընտանիքի ընդհանուր ամսական եկամուտը 2013 թվականին:** ☐ 1. Ոչ ավելի, քան 50,000 դրամ ☐ 2. 51,000 – 100,000 դրամ ☐ 3. 101,000 -250,000 դրամ ☐ 4. > 250,000 դրամ ☐ 5. Չգիտեմ						

Appendix E. Medical record data abstraction form

Demographic Characteristics	
1. ID#_____	
2. Date of birth DD MM YY ___/____/_____	
3. Patient sex	0.□ Female 1. □ Male
4**.** Employed	0. □ No 1. □ Yes
4a. Date of intervention DD MM YY ___/____/__ 4b.Date of hospital admission DD MM YY ___/____/__ 4c.Date of discharge DD MM YY ___/____/__	
Cardiac Status	
5. Stable angina	0.□ No 1.□Yes
6. Unstable angina	0.□ No 1.□Yes
7a. Past MI	7a. Yes/No; if Yes→ 1. □ ≤ 3 months before intervention 2. □ 4-6 months 3. □ > 6 months
8. Heart failure 9a.If Yes → NYHA class	0. □No, 1. □Yes 1. □ I 2. □II 3. □III 4. □IV
10. Ejection Fraction _____%	
11. Arrhythmia If Yes, Type of arrhythmia _____	0. □No 1. □Yes
12. Cardiogenic shock	0. □No 1. □Yes

13. Troponin enzyme level test	0. □Normal	1. □Probable MI
CAD Risk Factors and Comorbidities		
14. Weight (kg) _____ 15. Height (cm) _____		
16. Current smoking?	0.□No	1.□Yes
17.Past smoking (Last five years)	0.□No	1.□Yes
18.Family history of CAD	0.□No	1.□Yes
19. Hypertension	0.□No	1.□Yes
20. Hypercholesterolemia	0.□No	1.□Yes
21. Creatinine (70-120 mmol/l)	0.□No	1.□Yes
22. GI disease	0.□No	1.□Yes
23. Cerebrovascular disease (stroke/TIA)	0.□No	1.□Yes
24. Diabetes	0.□No	1.□Yes
25. Anemia	0.□No	1. □Yes
26. COPD	0.□No	1. □Yes
27.Other Please Specify _____		

PCI Intervention Data

28. Patient's agreement for complete revascularization 0. □No 1. □Yes 2. □Not available

29. Coronary angiography at the time of intervention 0. □No 1. □Yes

30.Vessel #1Stented Vessel diameter _____mm Stented Lesion length _____mm

Date (dd/mm/yy) _____

#2Stented Vessel diameter _____mm Stented Lesion length _____mm

Date (dd/mm/yy) _____

#3Stented Vessel diameter _____mm Stented Lesion length _____mm

Date (dd/mm/yy) _____

#4 Stented Vessel diameter _____mm Stented Lesion length _____mm

Date (dd/mm/yy) _____

29. The number of diseased vessels* 1.□Single 2.□Two 3.□Three vessel

32. Type of the diseased vessels (mark all that apply)

a. □ Left main % of narrowing _____

b. □ Left anterior descending % of narrowing _____

c. □ Left circumflex % of narrowing _____

d. □ Right coronary % of narrowing _____

e. □ Bifurcation % of narrowing _____

33. The number of stents placed 1. □ One 2. □ Two 3. □ Three□ 4. four□ 5.Five □

34. Stent type 0. □BMS 1. □DES 2. □ Both

35.Door to balloon time Hours/Minutes _____

36.In-hospital complications

Death	1□	GI bleeding	6□
Recurrent MI	2□	Vascular complication	7□
CABG	3□	Secondary infection/sepsis	8□
Stroke	4□	Blood transfusion	9□
		Other	10□
TIA	5□	specify_____	

35.Medication at discharge

Aspirin 1□

Clopidogrel 2□

ACEI 3□

b-blockers 4□

Statins 5□

Other _____

***** The diseased coronary vessels was defined as narrowing by >70% in diameter.

Appendix F. Journal form for the telephone survey

ID	Contact Date	Date of stent placement	Disposition codes	Other

Options for "Disposition Codes"

1. Valid response (Complete survey was received)
2. Incomplete response (Participant refuses to fully complete the survey)
3. Refusal (Participant refuses to complete the survey)
4. Absent from the country
5. Impossible to contact (temporary disconnect/no answer)
6. Dead (If dead, please specify the cause either cardiac or non-cardiac conditions and date of the death in the "Other" section)
7. Not at home
8. Made an arrangement for interview later on

Appendix G. Consent form (*English version*)

American University of Armenia

School of Public Health

Institutional Review Board #1

Consent form for PCI patients

Title of research project: Comparative Effectiveness of Complete Versus Culprit Artery- Only Percutaneous Coronary Revascularization for Multivessel Disease after ST-Segment Elevation Myocardial Infarction

Hello. My name is _____and I am calling on behalf of Joshua Chadwick Jayaraj who is a graduate student of the Master of Public Health program at the American University of Armenia and MD student at Yerevan State Medical University. He is a member of a research team that is conducting a study to investigate the outcomes of patients with PCI treated at NMMC. You have been contacted because based on NMMC records you underwent stenting in 2012-2014. You will be one of the approximately 400 people whom we are going to contact. Your contact information has been obtained from NMMC database. Permission to collect your contact information has been received from the NMMC Medical Board.

If you are willing to participate in this study, I will ask some questions concerning your health status. Your participation in the study is voluntary. You may skip any question you think is inappropriate and stop the interview at any moment you want with no further negative consequences. The interview will take place once at any time that is convenient for you and last no more than 10 minutes. If you don't mind, I will also collect some information from your medical records regarding your health status and intervention.

There will be no monetary benefits for you if you participate in this project. The information provided by you will be very helpful for science and other patients. There is no

penalty for refusing to participate.

Whether or not you are in the study will not affect your future treatment at the NMMC. The information provided by you or extracted from your medical record is fully confidential and will be used only for the study purposes. Only aggregate data will be reported. Your contact information will be destroyed upon completion of the research.

If you have more questions about this study, you can contact Dr. Anahit Demirchyan, Senior Research Specialist at AUA School of Public Health calling 060 612562. If you feel you have not been treated fairly or think you have been hurt by joining this study, please contact Dr. Kristina Akopyan, the Human Subject Protection Administrator of the American University of Armenia (37460) 61 25 61.

If you agree to be involved in this study, shall we continue?

Appendix H. Consent form *(Armenian version)*

Հայաստանի Ամերիկյան Համալսարան
Հանրային առողջապահության բաժին
Գիտահետազոտական էթիկայի թիվ 1 հանձնաժողով
Իրազեկ համաձայնության ձև

Ախտահարված պսակաձև զարկերակների լիակատար միջմաշկային վերաանոթավորման կամ միայն պատճառային զարկերակի վերաանոթավորման համեմատական արդյունավետությունը բազմանոթային ախտահարմամբ հիվանդների մոտ՝ ST էլեվացիայով սրտամկանի ինֆարկտից հետո

Բարև Ձեզ, իմ անունն է ————————————: Ես զանգահարել եմ Ձեզ Հայաստանի ամերիկյան համալսարանի Հանրային առողջության ֆակուլտետի ավարտական կուրսի ուսանող Ջոշուա Չադվիկ Ջայարաջի անունից, ով նաև Երևանի Մ. Հերացու անվան պետական բժշկական համալսարանի ուսանող է: Իր ավարտական թեզի շրջանակներում նա իրականացնում է հարցում Նորք Մարաշ բժշկական կենտրոնում ստենտավորում ստացած հիվանդների շրջանում՝ ստենտավորման տարբեր մոտեցումների համեմատական արդյունավետությունը պարզելու համար:

Մենք զանգահարել ենք Ձեզ, քանի որ, ըստ Նորք Մարաշ բժշկական կենտրոնի տվյալների բազայի, 2013 թվականինԴուք ստացել եք ստենտավորում այդ կենտրոնում: Դուք կլինեք հետազոտության մասնակցող մոտ 200 մարդկանցից մեկը: Ձեր հեռախոսահամարը վերցրել ենք այդ տվյալների բազայից: Ձեզ զանգահարելու թույլտվությունը տվել է Նորք Մարաշ բժշկական կենտրոնի Բժշկական խորհուրդը: Եթե Դուք համաձայն եք մասնակցել, ապա ես Ձեզ կտամ որոշ հարցեր Ձեր առողջական վիճակի վերաբերյալ: Ձեր մասնակցությունը կամավոր է: Դուք կարող եք հրաժարվել պատասխանել ցանկացած հարցի կամ ցանկացած պահի ընդհատել հարցազրույցը: Հարցազրույցը տեղի կունենա մեկ անգամ՝ Ձեզ առավել հարմար ժամանակ և չի տևի ավելի քան 10 րոպե: Եթե դեմ չեք, ես ձեր առողջության վիճակի և Ձեր տարած միջամտության մասին որոշ տեղեկություններ կվերցնեմ Ձեր հիվանդության պատմությունից ևս: Դուք որևէ ուղղակի օգուտ չեք ստանա այս հարցմանը մասնակցելուց, սակայն Ձեր տրամադրած տեղեկությունները շատ կարևոր են սպառնացող սրտամկանի ինֆարկտով հիվանդների բուժման ավելի արդյունավետ մոտեցումներ կիրառելու համար:

Այս հետազոտությանը չմասնակցելը որևէ բացասական հետևանք չի ունենա Ձեզ համար: Անկախ նրանից՝ կմասնակցեք այս հետազոտությանը, թե ոչ, ոչինչ չի ազդի Նորք Մարաշ բժշկական կենտրոնում Ձեր հետագա հսկողության կամ բուժման վրա: Ձեր տրամադրած բոլոր տեղեկությունները գաղտնի կպահվեն և միայն ընդհանրացված արդյունքները կներկայացվեն հետազոտության զեկույցում: Ձեր անձնական տվյալները անմիջապես կոչնչացվեն հետազոտության ավարտից հետո:

Հետազոտության հետ կապված հետագա հարցերի ունենալու դեպքում Դուք կարող եք կզանգահարել ՀԱՀ Հանրային առողջապահության ֆակուլտետի ավագ գիտաշխատող Անահիտ Դեմիրճյանին 060 612562 հեռախոսահամարով: Եթե Դուք գտնում եք, որ հետազոտության ընթացքում Ձեզ լավ չեն վերաբերվել և/կամ հետազոտությունը Ձեզ վնաս է հասցրել,ապա կարող եք զանգահարել ՀԱՀ գիտահետազոտական էթիկայի հանձնաժողովի քարտուղար Քրիստինա Հակոբյանին 060 612561 հեռախոսահամարով: Եթե համաձայն եք մասնակցել, կարող ենք սկսել: