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CARDIOPROTECTIVE MEDICATION USE IN POST MYOCARDIAL INFARCTION PATIENTS AT NMMC

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Table of contents

Summary

Background

Patients with a history of myocardial infarction remain at high risk for recurrent cardiovascular events and mortality. Secondary prevention improves survival and decreases the risk of recurrent evens in these patients. Recent treatment guidelines recommend universal prescription of antithrombotic agents, ß-blockers, angiotensin-converting enzyme inhibitors (ACEI), and statins to all patients with a history of myocardial infarction unless contraindications exist. This study was conducted in the scope of American University of Armenia (AUA) and Nork-Marash Medical Center (NMMC) collaborative Quality Assurance Project to assess the situation with prescription of cardioprotective medication in post-myocardial infarction patients at NMMC.

Methods

A cross-sectional record-review study of cardioprotective medication prescription in post-myocardial infarction (MI) patients was conducted at the Adult Cardiology Clinic (ACC) of the NMMC. The inclusion criteria were patients diagnosed with coronary artery disease with an acute myocardial infarction or a history of prior myocardial infarction. Records of all 133 patients with myocardial infarction whose primary visit to ACC was during 2004 were reviewed. The prescription rates were calculated with inclusion of only those patients having no contraindication for the given group of medication. For each group of medications, the factors significantly associated with prescription rates were found through logistic regression analysis using STATA 7.0 software.

Results

The prescription rate for aspirin was 96.1%, ß-blockers 60.8%, angiotensin-converting enzyme inhibitors (ACEI) 60.2%, and statins 13.6 %. The prescription patterns of the latter were nevertheless improved as compared to the available data from 2003 (6.3%, $p=0.03$). The only factor significantly associated with aspirin prescription patterns was gender of patients with less frequent prescription in women. No significant predictors were found for prescription of ß-blockers. Hypertension and ejection fraction < 40 were significant predictors for ACEI prescription, while stent placement and cholesterol testing were significantly associated with prescription of statins.

Conclusions

In terms of adherence to the existing treatment guidelines for post-MI patients, the study revealed a considerable treatment gap for statin prescription. The rates of ACEI and ß-blockers prescription were higher, but still lower than the recommended levels. The highest extent of adherence to guidelines was observed for aspirin prescription. Comparison of prescription rates of cardiovascular drugs in post-MI patients across different institutions showed higher prescription rates for ß-blockers and ACEI at NMMC as compared to several western outpatient clinics. The rates of statin prescription were lower than that reported from the majority of western outpatient settings. Several hypothesis were suggested to explain the treatment gaps of cardioprotective medication prescription, such as low affordability of drugs, focus of ACC providers on invasive procedures, and unsatisfactory exposure of providers to recent evidence-based guidelines recommending broader indications for cardioprotective medication prescription. Recommendations were made to increase awareness of/compliance with the advanced treatment guidelines of post-MI patients and improve patient-specific data recording at ACC.

Introduction

Patients that experience acute myocardial infarction (MI), remain at high risk for recurrent cardiovascular events and mortality (1). Patients with a prior history of MI are five to seven times more likely to sustain a cardio-vascular event compared with those without clinically evident atherosclerotic vascular disease (1). These patients remain at risk for recurrent events even if they are completely asymptomatic, have no demonstrated ischemia on stress testing, and even if they have undergone complete revascularization (1). According to US statistics of 2002, the mortality rate after acute myocardial infarction within one year is 25% for men and 38% for women (1). Within 6 years after experiencing acute myocardial infarction, the rate of recurrent MI is 18% among men and 35% among women, and the incidence rate of congestive heart failure is approximately 22% for men and 46 % for women (1).

Secondary prevention in patients with coronary heart disease improves survival and reduces the risk of recurrent events and cardiovascular mortality (2). The American Heart Association/ American College of Cardiology guidelines for preventing heart attack and death in patients with atherosclerotic cardiovascular disease, as well as other national and clinical guidelines recommend the use of aspirin, ß-blockers, angiotensin-converting enzyme inhibitors (ACEI), and hydroxymethylglutaryl coenzyme A reductase inhibitors (statins) in patients after acute myocardial infarction (AMI) unless contraindications exist (Table 1) (2,3,4). Antithrombotic agents, ß-blockers, ACE inhibitors, as well as lipid lowering drugs are associated with a clinically significant reduction in subsequent acute coronary syndromes, need for revascularisation, and mortality (5). However, many high-risk patients do not receive cardioprotective drugs (2,5).

Routine use of aspirin is recommended for patients after myocardial infarction in the absence of contraindications (3). If contraindications exist, aspirin may be substituted with other antiplatelet therapies like clopidrogel, and warfarin (3). ß-blockers and ACEI therapy are recommended for all patients with prior MI in the absence of contraindications (3). American Heart Association (AHA) myocardial infarction management guidelines for 2004 suggest using statins in all patients of this group (even when the baseline low-density lipoproteins [LDL] are lower than 2.5mmol/l) (4). Treatment rate with lipid-lowering therapy in patients after MI is increasingly viewed as an appropriate quality-of-care/performance indicator (1).

According to data from a National Survey in Switzerland, the rates of prescription of cardiovascular drugs to coronary artery disease (CAD) patients in outpatient settings were as follows: 91% for aspirin, 58 % for ß-blockers, 50 % for ACEI, and 63% for statins (5). For the same subset of population, the patients with history of MI had higher rates of aspirin, ß-blockers, and statins prescription. Prescription of ß-blockers was higher in patients with recent myocardial infarction. Larger difference in drug prescription was observed for antithrombotic agents and lipid lowering drugs between CAD patients who had either a history of myocardial infarction or coronary revascularisation and those who had neither (5).

According to Fonarow, less than half of patients with myocardial infarction are prescribed ß-blockers in an outpatient setting (7). In the Third National Health and Nutrition Examination Survey (NHANES III), lipid-lowering medication was used in only an estimated 11% of outpatient participants with a history of MI (1). Low lipid-lowering treatment rates for patients after MI in outpatient settings were observed even in leading academic medical centers, centers participating in secondary prevention trials, and prominent community cardiovascular care Centers (1).

The observed treatment gap for cardioprotectors could not be merely attributed to the lack of provider knowledge, because 95% of the surveyed physicians reported that they were knowledgeable on the National Cholesterol Education Program guidelines, and 65% reported that they followed the guidelines on most patients (6). Several factors could influence the prescription patterns of cardioprotectors: lack of provider training, time constraints, focus on acute problems, cost of medication, guidelines that recommend delaying initiation of therapy and call for multiple steps, time points, and treatment options (6). The setting of care is recently recognized as an important factor influencing treatment rates (1,6). Frequently, fewer resources are available in outpatient, as opposed to in-patient settings (1). Based on scientific evidence demonstrating that in-hospital initiation of medications results in a marked increase in treatment rates, improved long-term patient compliance, and improved clinical outcomes, American Heart Association / American College of Cardiology (AHA/ACC) developed Secondary Prevention Guidelines, which is now considered the standard of care (6).

Patient characteristics could also influence prescription habits of physicians. According to the above-mentioned survey in Switzerland, patients aged over 70 are prescribed ß-blockers and statins less frequently then those under 70 (5). The history of recent myocardial infarction and prior revascularization could increase the prescription rates of statins and antithrombotic agents (5). Reasons for not using ß-blockers after acute myocardial infarction may involve physicians' concerns regarding the safety and benefits of ß-blockers in post-myocardial infarction patients with left ventricular dysfunction with or without heart failure symptoms, with diabetes, chronic obstructive pulmonary disease, and older age (7).

This study was undertaken in the scope of AUA/NMMC Quality Assurance Project to evaluate the patterns of prescription of cardioprotective medications in post-myocardial infarction patients at NMMC Adult Cardiology Clinic. The findings of this study could be used to improve the secondary prevention of cardiovascular events at the clinic.

Research Question

The aim of the study was to evaluate the prescription of cardioprotective medications to patients with a history of myocardial infarction at NMMC.

The objectives of the study were:

- measure the prescription rates of cardioprotective medications (aspirin, ß-blockers, ACEI and statins) in post-myocardial infarction patients.
- identify patient characteristics and other factors serving as predictors for prescribing different groups of cardioprotective drugs to post-myocardial infarction patients at the Adult Cardiology Clinic.
- make recommendations to improve the secondary prevention of cardiovascular events at ACC.

Methods

A cross-sectional review of medical records at ACC was conducted. The inclusion criteria were patients diagnosed with coronary artery disease with an acute myocardial infarction or a history of prior myocardial infarction. Those patients diagnosed at admission as having IHD and MI, whose diagnosis was not confirmed after examinations (normal studies), were excluded from the study. The records of all patients (n=133) with myocardial infarction (acute or prior), whose

primary visit to ACC was during 2004, were reviewed. Initial patient information was abstracted from the computerized database of the clinic by the date of their first visit. This was followed by thorough review of medical records of eligible patients. A data collection tool was developed and pre-tested on 15 records (Appendix 1). The pre-testing resulted in several changes in the instrument to facilitate the data collection process.

Prescription of any drug was judged as positive if a prescription note was found in any of the patient forms (first visit, secondary visit, postsurgical visit SEFs or discharge summaries). If the medication of interest was not found among other prescribed drugs, its prescription was judged as negative. The prescription was judged as missing if above mentioned documents did not contain any notes on prescribed drugs in the "Prescribed medications" part of the SEFs.

The presence of contraindications to any of the four groups of cardioprotectors in any given case was judged based on the disorders and/or specific test results recorded in the medical forms (Table 1). For example, the presence of contraindications to ACEI inhibitors was assumed based on reported renal failure in a patient or measured Blood Urea Nitrogen (BUN) level higher than 200 mmol/l. The existence of contraindications for statin prescription was assumed based on reported active liver disease or increase in Alanine Aminotransaminase (ALT) level up to10 times (4).

Table 1. Contraindications to cardioprotectors

	Contraindication	Contraindication presence
Aspirin	Recent/active bleeding, gastrointestinal intolerance, allergy to aspirin	Reported disorder in the record
ß-blockers	Severe/poorly controlled asthma, bradycardia <50 bpm, history of Class IV heart failure, second- or third-degree AV block, systolic blood pressure <90	Reported disorder or measures of pulse rate/blood pressure in the record
ACEI	Allergy, angioedema due to ACE inhibitor, anuric renal failure due to ACE inhibitor, pregnancy, moderate or severe aortic stenosis, advanced renal failure, etc.	Reported disorder or measured BUN >200 mmol/l in the record
Statins	Active liver disease or unexplained persistent elevations of liver enzymes, high alcohol consumption, pregnancy and lactation	Reported disorder or measured ALT levels 10 times exceeding the normal levels

Ethical considerations

The study was a retrospective record review conducted as a part of an internal evaluation process in the scope of Quality Assurance program implemented at Nork-Marash Medical center by AUA/NMMC Collaborative Project since 2001. No identifying information was collected except record numbers. No risks were anticipated for patients and/or providers. However, the study protocol was submitted for review and approved under expedited review by the AUA Institutional Review Board.

Statistical analysis

SPSS 11.0 statistical package was used for data entry. Data analysis was performed through SPSS 11.0 and STATA 7.0 software. The prescription rates for each specific group of cardioprotective medication were calculated excluding the cases with contraindications to that specific group of drugs. For prescription of each group of cardioprotective medications, univariable logistic regression analysis was conducted to identify possible predicting factors for prescribing the given group of drugs. Then multivariable logistic regression analysis was conducted to create final models predicting prescription of each group of cardioprotective medications. The final models were evaluated by p-values, areas under the receiver operating characteristics (ROC) curve and goodness-of-fit test results.

Results

The mean age of the study population was 53.8 years (sd=12.4). The majority (68, 52.7 %) were from Yerevan, followed with those from regions (54, 41.9 %) and from abroad (7, 5.4%). Almost 80% of the study population were overweight (36, 50.0 %) or obese (21, 29.2%) according to body mass index (BMI) categories. Selected characteristics of the sample of patients are provided in Table 2.

Table 2. Selected characteristics of studied population

Characteristics	Frequency	Percent
Percutaneous coronary intervention (PCI)	22	16.5%
Coronary artery bypass graft (CABG)	28	21.1%
Female sex	10	7.5%
Acute myocardial infarction (AMI vs. MI)	31	23.7%
Diabetes	17	13.4%
Hypertension	34	27.6%
Poor ejection fraction (<40)	44	33.1%
LDL levels ≥100mg/dl	41	85.4%
Overweight (BMI >25)	57	79.2%

In 30 (22.6 %) cases, the medical forms did not contain any note on prescribed drugs. Thus, only the remaining 103 records were included in the analysis to calculate the prescription rates for cardioprotectors and to identify factors predicting those rates at ACC. The rates of prescription of cardioprotectors to post-MI patients having no recorded contraindications to any given group of drugs were 96.1% for aspirin, 60.2% for ß-blockers, 60.8% for ACEI, and 13.6% for statins (Table 3). Considering 100% as the target prescription rate, the existing treatment gap was the largest for statins (86.4%), followed by ß-blockers (39.8%) and ACEI (39.2%). The smallest treatment gap (3.9%) was revealed for aspirin.

Table 3. Prescriprion of cardioprotectors to post MI patients with no contraindications (n=103*)

	# Prescribed	Prescription rate (%)
Aspirin	99	96.1
ß-blocker	59	60.2
ACEI	62	60.8
Statins	14	13.6

* 5 cases with recorded contraindication to ß-blockers and 1 case with contraindication to ACEI were excluded from the analysis.

A variable was created indicating the number of cardioprotectors from different groups prescribed to each patient. Of 103 patients, 40 (38.8 %) received medications representing three groups of cardioprotectors: antitrombotics, ß-blockers and ACEI. Only 5 (4.9 %) patients received the full complex of cardioprotective medications representing all four groups: antitrombotics, ß-blockers, ACEI, and statins (Table 4).

Table 4. The number of received cardioprotective medication from different groups

Sum of received cardioprotectors representing different groups	Frequency	Percent
0	2	1.9
1	15	14.6
2	38	36.9
3	43	41.7
4	5	4.9
Total	**103**	**100.0**

Separate analysis was conducted for each group of cardioprotectors to reveal the prescribing patterns and predictors for each.

Aspirin: prescription rates, benchmark analysis, prescription predictors

Almost all patients were prescribed aspirin, except 4 cases (Table 2). No patients with contraindications to aspirin were found. The rate of aspirin prescription at NMMC was compared to that from the National Survey on Prescription of Cardioprotectors to Patients with Coronary Artery Disease in Outpatient Settings of Switzerland[i] (5). The rate of prescription of aspirin was found to be similar in NMMC outpatients as compared to Swiss outpatients (p=0.08).

The aspirin prescription rate in Ischemic Heart Disease (IHD) patients at ACC was 95.9 % in 2003 according to our previous study on Aspirin and Statin Use at NMMC (8). This rate is similar to the rate obtained in the current study among post-MI patients (p=0.9, Table 5).

[i] The population studied in Switzerland included CAD patients with or without history of myocardial infarction, which was different from this study selection (all had a history of myocardial infarction). No rates of aspirin prescription in post-MI patients in outpatient settings were found in the literature, that is why our rates were compared with those from the Swiss survey taking into consideration that the medication was indicated in both cases.

Table 5. Comparison of aspirin and statin prescription rates over a year

	2004 post-MI patients	2003 IHD patients	p-value
Aspirin prescription	96.1%	95.9%	0.910
Statin prescription	13.6%	6.3%	0.033

No significant differences were found in prescription rates of aspirin both across different physicians (p=0.17, Chi-square test) and by residency status of patients (p=0.07, Chi-square test). The univariate regression analysis showed that women are less likely to be prescribed aspirin as compared to men (Table 6). Since aspirin was prescribed in virtually all studied cases, no model was constructed to predict its prescription.

Table 6. Univariate analyses of predictors for prescribing aspirin

Predictor variables	Odds ratio	CI	P-value
Age	0.91	0.81-1.01	0.076
Female sex	0.03	0.002-0.28	0.003*
Hypertension	0.13	0.01-1.34	0.087
CABG	1.07	0.11-10.73	0.995
BMI	0.91	0.76-1.10	0.327
Number of follow-up visits	2.91	0.48-17.7	0.247

* Significant predictor

ß-blockers: prescription rates, benchmark analysis, prescription predictors

ß-blockers were prescribed to 60.2 % of post-MI patients included in the study sample. The rate of ß-blocker prescription was significantly higher (p=0.04) at NMMC as compared to the rate reported by Fonarow for post-myocardial infarction patients in an outpatient setting (7). Among studied, no factors significantly influencing the prescription of ß-blockers were found at NMMC (Table 7).

Table 7. Univariate analyses of predictors for prescribing ß-blockers

Predictor variables	Odds ratio	CI	P-value
Age	1.00	0.97-1.04	0.801
Female sex	0.99	0.26-3.77	0.989
PCI	1.22	0.37-3.98	0.736
CABG	0.50	0.21-1.24	0.136
Hypertension	2.06	0.79-5.38	0.141
Number of follow-up visits	0.92	0.69-1.22	0.557

ACEI: prescription rates, benchmark analysis, prescription predictors, and model

ACEI were prescribed to 60.8 % of the sample with no reported contraindications to this group of drugs. Only one patient was found with contraindication to ACEI reported in the medical form and was excluded from further analysis. The rates of prescription of ACEI were compared to those from the National Survey in Switzerland (5). The rates at NMMC were significantly higher as compared to those reported by Swiss outpatient providers (p=0.04).

No difference in prescription practice of ACEI was found across physicians (p=0.26, Chi-square test). The Chi-square test showed significant difference (p=0.005) for prescription of this group of medications by residency status of patients. Patients from abroad were prescribed ACEI less frequently then those from Armenia. Univariate regression analysis revealed that the presence of heart failure, hypertension, and ejection fraction <40 increased the probability of a patient being prescribed an ACEI (Table 8).

Table 8. Univariate analyses of predictors for prescribing ACEI

Predictor variables	Odds ratio	CI	P-value
PCI	0.51	0.17-1.53	0.231
CABG	0.74	0.31-1.82	0.517
Age	1.03	0.99-1.06	0.072
Sex	1.32	0.31-5.62	0.706
HF	4.29	1.16-15.85	0.029*
AMI	0.54	0.21-1.36	0.193
BMI	0.97	0.87-1.08	0.586
Diabetes	1.60	0.51-5.03	0.418
Hypertension	2.69	1.04-7.18	0.048*
EF	0.91	0.86-0.96	0.001*
EF grouped (<40, =>40)	7.00	2.42-20.23	0.000*
Number of follow-up visits	1.22	0.89-1.68	0.207

* Significant predictor

After the univariate analysis, multiple logistic regression was conducted to examine the effect of an individual variable on prescription of ACE inhibitors while controlling for the others. The final model was checked for potential confounders and interactions (Table 9).

Table 9. Final model : prescription of ACEI

	Odds ratio	CI	P-value
Hypertension	3.66	1.26-10.61	0.017
EF <40	8.04	2.62-24.61	0.000

Based on the model, patients with hypertension had higher risk for being prescribed ACEI when controlling for ejection fraction. The final model had high validity with acceptable calibration (Goodness-of-fit test 0.4045) and discrimination (Area under the ROC curve 0.7496) (Table 9).

Statins: prescription rates, benchmark analysis, prescription predictors, and model

Statin prescription was 13.6% among the studied population of post-MI patients. There were no patients in the sample with reported contraindications to statins. The statin prescription rate was similar to the rate reported by NHANNES III (11 %, p=0.447), but was significantly lower (p<0.001) at NMMC as compared to the rates reported by several other outpatient settings (25% from Pearson et al, 29% from Sueta et al, 39% from Schrott et al, 52% from Pearson et al) (1).

According to our prior study, the prescription rate of statins to IHD patients at NMMC was 6.25% in 2003 (8). The identified rate of prescription of statins to post-MI patients was now significantly higher (p=0.03) (Table 5). This difference could be attributed either to the real

change in the practice over a year period or the possibility that history of myocardial infarction increases the probability of statin prescription.

Of 133 patients, 48 (36.1 %) had laboratory test result sheets with total cholesterol measures, and 42 (31.6 %) with the results for the whole lipid profile in their medical forms. According to the 2003 study results (8), the rate for total cholesterol tests was 28.1% and for lipid profile tests 23.8 %. However, the difference between 2003 and 2004 rates was not statistically significant for either test (p=0.14 and p=0.13 respectively).

No difference in the statin prescription practice was found accross different physicians (p=0.21, Chi-square test) or by residency status of patients (p=0.33, Chi-square test). Univariate regression analysis was performed to find predictors for prescribing lipid-lowering medications (Table 10).

Table 10. Univariate analyses of predictors for prescribing lipid-lowering medication

Predictor variables	Odds ratio	CI	P-value
PCI	6.67	1.89-23.57	0.003*
CABG	1.15	0.33-4.01	0.829
Age	0.96	0.92-1.00	0.062
Sex	0.68	0.08-5.86	0.729
AMI	8.76	2.57-29.86	0.001*
BMI	1.10	0.96-1.27	0.172
Diabetes	1.40	0.35-5.68	0.636
Hypertension	0.58	0.15-2.25	0.428
EF	1.14	0.96-1.34	0.128
EF grouped (<40, =>40)	0.26	0.05-1.22	0.087
Cholesterol test availability	8.42	2.17-32.62	0.002*
High LDL	1.74	0.17-17.58	0.639
Number of follow-ups	1.61	1.13-2.31	0.009*

* Significant predictor

After the univariate analysis, multiple logistic regression analysis was conducted to examine the effect of an individual variable on prescription of statins while controlling for the others. The final model was checked for potential confounders and interactions (Table 11).

Table 11. Final model: prescription of statins

	Odds ratio	CI	P-value
PCI	4.33	1.12-16.78	0.034
Cholesterol test availability	6.53	1.62-26.37	0.008

Based on the model, patients who underwent stent placement had a higher probability of being prescribed statins when controlling for cholesterol testing. The final model had high validity with acceptable calibration (Goodness-of-fit test 0.6564) and discrimination (Area under the ROC curve 0.7933).

Limitations

The limitations of the study were mainly attributed to recording flaws at ACC. Out of 133 patient records, 30 (22.6 %) did not contain any note on prescribed drugs. Also, the study design did not allow checking the accuracy of physician/nurse records, which might result in a bias from missreported data.

Another limitation of the study was possibility of a selection bias because of non-verified history of myocardial infarction reported by patients. In some cases, the diagnosis of prior myocardial infarction (diagnosed in other institutions) could be uncertain and the cardiologist could neither reject nor support it by the objective data.

Discussion

Aspirin was prescribed to virtually all post-MI patients at ACC. The rate of aspirin prescription was similar to that revealed by the National Survey in Switzerland (5). The prescription rate of ß-blockers in post-MI patients at NMMC was higher than that reported by Fonarow (7). The prescription rate of ACEI was also higher at NMMC as compared to the Swiss data (5). The observed difference between outpatient settings of NMMC and Switzerland in terms of ACEI prescription patterns of providers could be attributed to a real difference or the fact that, aside from cardiologists, general practitioners were also involved in the Swiss survey and the studied patient populations were slightly different. The rate of statin prescription at ACC was not different from that reported by NHANES III, but much lower than the rates reported by many other outpatient settings (1).

The dynamic of aspirin prescription rates during 2003-2004 did not show any significant change. The rate of statin prescription, however, significantly increased in 2004 as compared to 2003 data. This difference could be explained either by real increase of the prescription rate over a year period or the fact that the study subjects in 2003 survey were not limited to those with a history of MI, as was the case in this study. If the latter is true, one may conclude that the history of previous myocardial infarction/acute myocardial infarction in IHD patients influences the prescription patterns of providers.

The prescription of aspirin was higher among men as compared to women. Similar results were obtained by the National Survey in Switzerland, but they found that their findings were confounded with the history of myocardial infarction or revascularization (5). No confounder was found for the less frequent prescription of aspirin to the female patients at NMMC. One of the possible reasons for not prescribing aspirin to women could be the uncertainty of their myocardial infarction diagnosis.

No patient-related factors were found that impact the prescription of ß-blockers at NMMC. None of the well-known reasons (like the age over 70 mentioned in the Swiss Survey) were found to influence the prescription rate of ß-blockers in this study population.

Multivariate logistic regression analysis revealed that hypertension and ejection fraction <40% influence the patterns of ACEI prescription of NMMC providers. These findings could be explained by the fact that hypertension and low ejection fraction in IHD patients alone without a history of MI are indications for ACEI prescription (2).

Multivariate logistic regression analysis for statin prescription revealed two significant predictors: PCI and presence of cholesterol test results. Several studies reported that a history of revascularization could increase the rates of prescription of cardioprotectors, particularly, statins to CAD patients (3). According to an interventional cardiologists at ACC, the outpatient cardiology clinic at NMMC is more oriented toward interventional cardiology and thus more focused on interventional patients. The presence of cholesterol test results likely shows the intention of physician to check the cholesterol level to later make a decision about statin prescription.

The largest treatment gap at ACC was revealed for statins prescription. The treatment gap for prescription of ß-blockers and ACEI was less as compared to statins but still substantial. The existing gap of prescription of cardioprotectors was explained by an NMMC cardiologist by several reasons. One possible reason was that many patients might be unable to pay for medications, thus pressing a physician to leave only the ones that are less expensive and/or most important for the particular patient. Another reason was that AHA/ACC guidelines were comparatively new for the ACC cardiologists.

The indications for cardioprotectors' use became broader in recent guidelines. For example, according to recent knowledge, all myocardial infarction patients benefit from statins irrespective of their cholesterol level (4). Benefits of the treatment with ß-blockers were expanded to patients with left ventricular dysfunction with or without heart failure symptoms (7). Many conditions that previously were considered as contraindications for ß-blockers are now viewed as not "absolute". For example, for several conditions (COPD, diabetes, peripheral artery disease, compensated HF, and mild asthma) the benefits of ß-blockers may outweigh the risks (4).

ACEI were shown to reduce the risk of cardiovascular events in post-MI patients at higher risk (elderly, LV dysfunction). Some benefits were also shown in lower risk patients (e.g. young, no LV dysfunction) regardless of the presence of hypertension (4). These recommendations were reflected in prescription patterns of ACC providers in respect of higher risk groups. Patients with hypertension and heart failure had higher probability for being prescribed ACEI at NMMC.

The treatment gap for statin prescription, to some extent, could be explained by its under-recording. According to the accepted practice at ACC, physicians often prescribe patients low-fat diet first and only later on (if the LDL does not reach <100mg/dl) statins, the prescription of which could be underreported in the follow-up forms. According to recent telephone interviews among patients with prior history of MI who underwent stent placement at NMMC, the rate of statin prescription was 43.1% (9). However, similar rate of 40.0 % ($p=0.83$) was found in the present study for the subgroup of those post-MI patients, who underwent interventional procedure. Thus, the treatment gap with statin prescription could not be merely explained by poor recording. Other potential reasons include the high cost of medications of this group and relatively recent availability of statins in the market as compared to the remaining cardioprotectors.

Another factor reported by several studies as influencing the prescription habits of providers is the treatment setting. The studies show higher probability of statin initiation in inpatient settings vs. outpatients because of fewer available resources in the latter (1). Existence of earlier treatment guidelines that recommend delaying initiation of statin therapy after an acute event and call for multiple steps, time points, and treatment options, is another factor that may result in lower prescription rates in outpatient settings (1). Patients could be lost from follow-up in an

outpatient clinic, because the first chance for beginning treatment was postponed to a time when the patients may no longer feel they are at risk for recurrent events (1).

Recent studies recommend early initiation of statins (other secondary prevention measures) in inpatient settings for several reasons. Hospitalization can serve as a teaching opportunity for patients and their physicians regarding the importance of cardioprotective therapy to their long-term cardiovascular health (1). Initiating the lipid lowering treatment before discharge could increase utilization of statins from 6% to 86% (1). Institution of lipid-lowering therapy in the in-patient setting for patients hospitalized with acute MI has a number of advantages: measurement of lipid levels can be systematically integrated into the diagnostic testing performed during cardiac hospitalization, the cost of the therapy will not influence patient decision on utilization, the structured setting can facilitate the initiation of lipid-lowering treatment through the use of physician prompts and reminders and involvement of other healthcare professionals, hospital-based initiation of therapy may help to minimize patient concerns regarding medication tolerability and side effects (1).

In summary, our study demonstrates that due to prescription practices the benefits from all the other groups of cardiopritectors except aspirin are not fully utilized at NMMC ACC and there is a room for improvement. However, as compared to the available data from western outpatient settings, the prescription rates for ACEI and ß-blockers among outpatients with a history of myocardial infarction are similar or even higher at NMMC. Concerning the statin prescription rate, it is still very low, even considering the possible improvement in the practice over the last year.

Recommendations

Based on the results of the study on cardioprotective medication use at ACC, the following measures are recommended:

- Adapt and implement the current treatment guidelines for post-MI patients;
- Improve recording patterns in primary, follow-up and postsurgical record forms;
- Increase the rate of patients tested for cholesterol and lipid profile;
- Initiate statin prescription in inpatient departments of NMMC after stent placement or CABG procedure.

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Appendix 1.

Data collection form for evaluating cardioprotective medication use in patients with a history of myocardial infarction

Card number			
physian			
PCI			
CABG			
Age			
Sex			
Address			
Phone			
Diagnosis			
NYHA			
MI or AMI			
Weight			
Height			
Allergy			
Diabetes			
Lungs			
Hypertension			
Renal system			
GIT			
BP (systolic)			
BP (diastolic)			
Pulse			
Ejection fraction			
Aspirin			
ß-blocker			
ACEI			
Statin			
Other			
visit2			
bp2			
ef2			
Aspirin2			
ß-blocker 2			
ACEI2			
Statin2			
Other2			
Test date			
BUN			
Creatinin			
Glucose			
ALT			
Total cholesterol			
Triglycerides			
HDL			
LDL			
Number of visits			