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ORIGINAL ARTICLE

Improving the Prescribing Gap For Guideline Recommended Medications Post Myocardial Infarction

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Background We assessed the effect of a pre-discharge medication checklist on discharge prescription rates of guideline recommended medications following myocardial infarction. In addition, we assessed what proportion of the residual prescribing gap following implementation of the checklist was due to the presence of contraindications.

Methods We examined baseline prescription rates of guideline recommended medications in 100 patients discharged from our institution following acute myocardial infarction. We then introduced a pre-discharge checklist and reassessed discharge medications and reasons for non-prescription of guideline recommended medications in 447 patients with acute myocardial infarction.

Results We demonstrated a significant gap in the prescription of guideline recommended secondary prevention medications at the time of discharge in our pre-intervention cohort. Introduction of a pre-discharge checklist resulted in a significant improvement in the prescription rates of all guideline recommended secondary prevention medications, with aspirin increasing from 90% to 97% ($p = 0.004$), Adenosine diphosphate (ADP) receptor antagonist from 84% to 96% ($p = 0.0001$), B-blocker from 79% to 87% ($p = 0.03$), statin from 88% to 96% ($p = 0.002$) and angiotensin converting enzyme (ACE) inhibitor from 58% to 70% ($p = 0.03$). The residual gap in prescribing was largely explained by the presence of contraindications or absence of an indication in the case of ACE-inhibitors. Once these were taken into account there was a residual gap of 0–4% which represents genuine non-adherence to the guidelines.

Conclusions Introduction of a pre-discharge checklist led to significant improvement in prescription rates of all five guideline recommended secondary prevention medications. The residual gap in medication prescription following introduction of the checklist was largely due to the presence of contraindications rather than non-adherence.

Keywords Acute myocardial infarction • Secondary prevention • Evidence-based medicine • Guideline adherence

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Introduction

Numerous large, randomised, controlled clinical trials have clearly demonstrated the substantial benefits of secondary preventive medications following myocardial infarction. Based on this large evidence base, international guidelines for treatment of acute coronary syndromes (ACS) recommend prescription of dual antiplatelet therapy, statins, beta blockers and angiotensin converting enzyme (ACE) inhibitors following myocardial infarction [1–4]. There is compelling evidence that improved adherence to these guidelines translates to a reduction in mortality [5,6].

Despite this robust evidence base, studies continue to show a significant gap in the use of guideline recommended medications following myocardial infarction [7–12]. Reducing errors of omission, that is failure to provide evidence-based therapies, is clearly important and recently there has been a focus on implementing strategies to achieve this [13–15]. Checklists are increasingly recognised as effective and safe means of increasing adherence to best practice in health care settings [16]. In this regard, they form a useful tool aiding clinician prescription choices at the time of discharge post myocardial infarction [5].

It is also important to recognise that the gap in prescribing secondary prevention medications is likely to be due to a combination of errors of omission and the presence of contraindications to prescribing [17]. Because large registries usually do not collect data on the reasons for non-prescription currently, there is limited data on what proportion of the prescribing gap for secondary prevention medications is due to non-adherence and what proportion is due to the presence of contraindications to prescribing.

The aim of this study was, firstly, to quantify the existing gap in prescription of guideline recommended secondary prevention medication post myocardial infarction at our institution. Secondly, we aimed to assess whether introduction of a pre-discharge medication checklist would improve prescription rates of guideline recommended medication. Finally, we assessed what proportion of the residual prescribing gap following implementation of the checklist was due to non-adherence and what proportion was due to the presence of contraindications to prescribing.

Methods

Patient Enrolment

We identified a pre-intervention cohort of 100 consecutive patients discharged from our institution following acute myocardial infarction between May and September 2014 from the Wellington ACS registry. The Wellington ACS registry prospectively enrolled patients with acute myocardial infarction undergoing invasive management who are adequately pretreated with dual antiplatelet therapy, but the analysis of discharge prescription was retrospective. Patients were excluded if they had a platelet count less than 100×10^9 /L, known platelet function disorder, administration of a fibrinolytic agent within 24 hours of enrolment or administration of a glycoprotein IIb/IIIa receptor antagonist within a week prior to enrolment. The Wellington ACS registry was reviewed and approved by the Central Regional Ethics Committee. All patients provided written informed consent.

From September 2014 until July 2015 an intervention cohort of 447 consecutive patients discharged from the Cardiology Service of Wellington Hospital following acute myocardial infarction was prospectively enrolled in to the study. Patients could either be admitted directly to Wellington Regional Hospital or referred for coronary angiography or percutaneous coronary intervention from secondary hospitals. Patients who died during admission and those who proceeded to in-patient coronary artery bypass surgery were excluded. Myocardial infarction was diagnosed in accordance with the third universal definition of myocardial infarction [18]. This project was introduced as a quality improvement initiative and conforms to the New Zealand standard for observational research.

Data Collection

Patient demographics, clinical characteristics, admission and discharge medications were recorded prospectively. Clinical management, including discharge medication prescription was at the discretion of the attending physician.

Intervention

A pre-discharge medication checklist was used as a prompt to prescription of guideline recommended medication for this group of patients (supplementary data Figure 1). This was placed in each patient's notes at the time of admission and was completed at the time of discharge. The form documented whether or not aspirin, an ADP receptor antagonist (clopidogrel or ticagrelor), a statin, a beta blocker or an ACE-inhibitor or angiotensin receptor blocker had been prescribed and, if not, whether a contraindication was present. Absence of a contraindication to these medications was meant to prompt prescription if this had not already occurred. Two physicians were delegated responsibility for ensuring completion of the pre-discharge checklist.

Statistical Analysis

Categorical variables are expressed as frequencies and percentages. Continuous variables are expressed as mean and standard deviation. Statistical analyses were performed with Chi squared tests for dichotomous data and independent t-tests for continuous data. For all statistical analyses a p-value <0.05 was considered significant. All statistical tests were performed using SPSS version 22 (IBM, Armonk, NY).

Results

The demographic data, clinical characteristics and admission medications for both the pre and post-intervention groups are shown in Table 1. There were no significant differences between the two groups.

Table 1 Demographics, clinical characteristics and admission medications.

	Pre-checklist n = 100	Post-checklist n = 447 (%)	P value
Age (mean ± SD)	64.2 ± 11.8	64.5 ± 11.5	0.9
Male	64 (64%)	308 (68.9)	0.41
Risk factors			
Hypertension	61	259 (57.9)	0.65
Dyslipidaemia	62	249 (55.7)	0.29
Diabetes mellitus	15	86 (19.2)	0.40
Diet controlled	2	14 (3.1)	
Oral	10	50 (11.2)	
Insulin	3	26 (5.8)	
Current smoker	23	96 (21.5)	0.84
Family history of premature CAD	18	87 (19.5)	0.84
Prior MI	27	100 (22.4)	0.39
Prior PCI	16	74 (16.6)	0.89
Prior CABG	11	32 (7.2)	0.28
Cerebrovascular disease	7	35 (7.8)	0.94
PVD	5	20 (4.5)	0.82
Admission medications			
Aspirin	40	160 (35.8)	0.50
Clopidogrel	4	31 (6.9)	0.39
Ticagrelor	1	5 (1.1)	0.92
Beta blocker	31	119 (26.6)	0.45
Statin	38	161 (36.0)	0.80
ACE-inhibitors	31	123 (27.5)	0.57
Angiotensin receptor blocker	6	37 (8.3)	0.58

Abbreviations: CABG, coronary artery bypass surgery; CAD, coronary artery disease; MI, myocardial infarction; PCI, percutaneous coronary intervention; PVD, peripheral vascular disease; ACE, angiotensin converting enzyme.

Table 2 Discharge medications pre and post introduction of a discharge checklist.

	Pre-checklist n = 100	Post-checklist n = 447	P value
Aspirin	90%	96.6% (432)	0.004
ADP receptor antagonist.	84%	96.4% (431)	0.0001
Beta blocker	79%	87.3% (390)	0.03
Statin	88%	96.0% (429)	0.002
ACE inhibitor/ARB	58%	69.6% (311)	0.03

Abbreviations: ADP, Adenosine diphosphate; ARB, angiotensin receptor blocker; ACE, angiotensin converting enzyme.

There was significant variation in the prescription rates of guideline recommended secondary prevention medications at the time of discharge in the pre-intervention group (Table 2). Consistent with previous studies the prescription rates were highest for aspirin and lowest for ACE-inhibitors or angiotensin receptor blockers. Introduction of a discharge medication checklist resulted in a significant improvement in prescription rates for all of the guideline recommended secondary prevention medications in the intervention group when compared to the pre-intervention cohort (all $p < 0.05$) (Table 2).

Despite improvement following the introduction of the discharge checklist there remained a gap of between 3.4% and 30.4% in the prescription of guideline recommended medications at discharge. We assessed whether this residual gap in prescribing in the intervention group was due the presence of contraindications, lack of an indication in the case of ACE inhibitors or unexplained non-adherence (Table 3).

Contraindications to prescribing were infrequent (<4%) for aspirin, ADP receptor antagonist and statins. Contraindications to beta blockers (9.6%) and ACE inhibitors or angiotensin receptor blockers (9.8%) were more frequent.

Table 3 Reasons for non-prescription of medications.

	Prescribed at discharge	Contraindicated or not indicated	Nature of Contraindication	Unexplained non-adherence
Aspirin	432 (96.6%)	15 (3.4%)	Oral Anticoagulants 8 Allergy 7	0 (0%)
ADP receptor antagonist	431 (96.4%)	12 (2.7%)	Oral Anticoagulants 4 Bleeding 3 Awaiting OP surgery 3 Other 2	4 (0.9%)
Beta blocker	390 (87.3%)	43 (9.6%)	Bradycardia 15 Asthma 12 Hypotension 5 COPD 4 PVD 4 Other intolerance 3	14 (3.1%)
Statin	429 (96.0%)	12 (2.7%)	Myopathy 4 Patient refusal 3 Allergy 3 GI intolerance1 Other 1	6 (1.3%)
ACE inhibitor/ARB	311 (69.6%)	118 (26.4%)	No indication 74 Hypotension 34 Renal impairment 9 Other intolerance 1	18 (4.0%)

Abbreviations: ADP, Adenosine diphosphate; ARB, angiotensin receptor blocker; ACE, angiotensin converting enzyme.

The most common contraindications to aspirin prescription were use of oral anticoagulants (1.8%) followed by allergy (1.6%). The most frequent contraindications to an ADP receptor antagonist were prescription of an oral anticoagulant (0.9%) followed by recent bleeding (0.7%). The most frequent contraindications to prescription of a beta blocker were bradycardia (3.4%) and asthma (2.7%). The main contraindications to statin prescription were myopathy (0.9%) followed by patient refusal (0.7%) and allergy (0.7%). The main reasons for lack of prescription of an ACE inhibitor or angiotensin receptor blocker were lack of an indication (16.6%), hypotension (7.6%) or renal impairment (2%).

For aspirin, the presence of contraindications completely accounted for the gap in prescribing. For the remaining guideline recommended medications the gap in prescribing was largely explained by contraindication or lack of indication in the case of ACE-inhibitors/angiogtensin receptor blockers. Once these were taken into account there was a residual gap of 0 to 4% which represents genuine non-adherence to the guidelines.

Discussion

Consistent with previous findings, we have demonstrated that there was a significant gap in the prescription of guideline recommended secondary prevention medications at the time of discharge in our pre-intervention cohort. We subsequently demonstrated that introduction of a pre-discharge checklist resulted in significant improvement in prescription rates of all five guideline recommended secondary prevention medications and that the residual gap in medication prescription following introduction of the checklist was largely due to the presence of contraindications rather than non-adherence.

Our findings in the pre-intervention cohort are consistent with multiple other studies that have also demonstrated the under-utilisation of guideline recommended secondary prevention medications following myocardial infarction. As we did not collect information about, or correct for, the presence of contraindications to prescribing in our pre-intervention cohort the gap observed over-estimates non-adherence to therapy. The prescription rates of guideline recommended medications in our pre-intervention cohort are generally similar or better than those reported in other studies that have not corrected for in the presence of contraindications [7,10,11].

Previous studies have demonstrated that dissemination of guidelines alone is not sufficient to optimise performance. Rather, interventions directed at changing systems of care are needed to improve the gap between clinical practice and guideline recommendations [13–15]. In order to improve adherence to guideline recommended therapy and to identify whether non-prescription was due to the presence of contraindication or non-adherence we introduced a pre-discharge checklist. Following introduction of the checklist

there was significant improvement in the prescription of all the guideline recommended secondary prevention medications. This is consistent with previous studies that have demonstrated a standardised order sheets for ACS may be helpful, both at the time of admission and at the time of discharge [19,20]. It is known that increased adherence is associated with improved outcomes [5,6], thus our pre-discharge checklist represents an easily reproducible means of improving compliance and potentially clinical outcomes. Although ongoing follow-up and monitoring of long-term medications use is necessary to optimise long-tem adherence, initiation of medications for all eligible patients at the time of discharge is a key point and is also important [21,22].

An important finding of this study was that the residual prescribing gap following implementation of the pre-discharge checklist was largely due to the presence of relative contraindications to prescribing. Many of the large registries reporting prescription rates of guideline recommended medication following myocardial infarction do not collect data on the reasons for non-prescription or attempt to retrospectively assess patient eligibility [7,8,10,11,21]. Failure to assess relative contraindications or inaccuracies in the assessment of eligibility may lead to either over- or under-estimation of physician adherence. For this reason the ACC/AHA 2008 Performance Measures for Adults With ST-Elevation and Non–ST-Elevation Myocardial Infarction state that those with documented contraindications be removed from the denominator when assessing discharge prescription rates [17]. Unexplained non-adherence was slightly higher for beta blocker use and ACE inhibitor use in our cohort than for the other three agents assessed, and it is possible that the lower evidence regarding the value of these two secondary prevention therapies may have contributed to this larger non-adherence.

There is limited information regarding the frequency of relative contraindications to guideline recommended therapies in contemporary practice. In our study, contraindications to prescribing for aspirin, ADP receptor antagonists and statins were infrequent occurring in <4% of patients. Contraindication to the prescription of beta blockers and ACE inhibitors were more frequent occurring in about 10% of patients. The presence of relative contraindications to guideline recommended secondary prevention medications in our study was much lower than in previous studies which have reported rates of between 15% to 50% [9,12]. This suggests that there is either a difference in the populations or that there is a difference in the way that eligibility or contraindications to these medications is being assessed. In our study the presence of contraindications was assessed prospectively at the time of discharge with the specific contraindication needing to be documented on the checklist.

Our study has the limitation of being a single centre study. The baseline demographics and comorbidities of our pre-intervention and intervention cohorts are typical of those presenting with acute myocardial infarction and are similar to those reported in other registries. The pre-intervention group was from an ACS study registry that did exclude some patients. It is possible that this group was slightly different from the post-checklist group although their demographic characteristics were similar. The pre-intervention prescription rates in our study are generally similar to or better than those reported in other studies. This suggest that are findings are likely to be generalisable to a broader population. Because our study was a pre- and post-intervention study, it is important to note that other temporal factors may have influenced prescription rates seen across the two cohorts.

Conclusions

Consistent with previous findings, our study demonstrated that there was a substantial gap in prescription of guideline recommended medications for secondary prevention of acute myocardial infarction at the time of discharge. Introduction of a pre-discharge checklist to prompt discharge prescription resulted in a significant improvement in the rate of prescription of all guideline recommended medications. The residual prescribing gap was largely due to the presence of relative contraindications with only a small amount being due to non-adherence. Previous studies have demonstrated that dissemination of guidelines alone is necessary but not sufficient to achieve significant changes in performance. We believe our pre-discharge checklist represents an easily reproducible means of increasing adherence rates.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.hlc.2017.10.025.

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