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A pre-printed medication chart in the ICU for patients admitted after coronary artery bypass graft surgery improves prescribing of secondary prevention at hospital discharge

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Abstract

***Objective*: To determine whether the introduction of a pre-printed Intensive Care Unit (ICU) drug chart after coronary artery bypass graft surgery (CABG) surgery was associated with an improvement in the rates of prescription of secondary prevention medicines at hospital discharge.**

***Design*: Retrospective cohort study.**

***Setting*: Tertiary cardiothoracic referral hospital in Wellington, New Zealand.**

***Patient and participants*: Seven hundred twenty-eight CABG surgery patients. Three hundred seventy-one from the year before and 357 from the year after the introduction of the pre-printed ICU cardiac drug chart.**

***Interventions*: A pre-printed ICU medication chart including aspirin, metoprolol, and atorvastatin used on all patients admitted to the ICU following CABG surgery.**

***Measurements*: The primary outcome variable was the proportion of patients prescribed appropriate secondary prevention at hospital discharge. Secondary outcome variables included the proportion of patients receiving each of: aspirin, a beta-blocker, or a statin individually.**

***Results*: Prescribing of appropriate secondary prevention increased from 81.1% to 92.7% following the introduction of the chart, adjusted OR 2.63 (1.53 to 4.50), p<0.001. The association between year of prescription and overall prescribing was mainly due to an increase in the prescription of beta-blockers.**

***Conclusions*: Introduction of a pre-printed ICU cardiac drug chart was associated with an increase in the rates of prescribing of secondary prevention on hospital discharge post-CABG surgery.**

Key words: Coronary artery bypass graft surgery, secondary prevention, medication charts, translational medicine, drug utilization.

Introduction

Cardiovascular disease is the world's leading cause of death. (1) Among selected patients with coronary artery disease (CAD), coronary artery bypass graft (CABG) surgery decreases morbidity and mortality. (2) Despite this, up to a quarter of patients develop graft occlusion within one year of surgery. (3) Pharmacotherapy is a cornerstone of secondary prevention of CAD including graft occlusion. The 2011 American College of Cardiology Foundation/American Heart Association Task Force guidelines recommend that, unless contraindications exist, all patients who have CABG surgery should be discharged home on aspirin, a beta-blocker, and a statin. (4) Despite the benefits of these secondary prevention medications, (5) their use after coronary revascularisation is often suboptimal. (6-8)

Hospital discharge following CABG surgery represents a unique opportunity to modify medical therapy to ensure secondary prevention measures are in place. Our hypothesis was that introducing a pre-printed Intensive Care Unit (ICU) drug chart after CABG surgery would improve the rates of prescription of secondary prevention medicines at hospital discharge.

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Materials and Methods

Overview

This retrospective cohort study evaluates the effect of a pre-printed ICU medication chart on the hospital-discharge prescribing rates of secondary prevention following CABG surgery. This study was approved by the New Zealand Central Regional Ethics Committee (reference number: CEN/12/EXP/028).

Population and setting

The details of all patients admitted to the Wellington Hospital ICU are prospectively recorded in a database. This was used to identify CABG surgery patients from the year before, 2009, and the year after, 2011, the introduction of the pre-printed ICU cardiac drug chart. Wellington Regional Hospital is a cardiothoracic tertiary referral hospital.

Pre-printed medication chart

The pre-printed ICU medication chart was developed for use on all patients admitted to the ICU following CABG surgery. The pre-printed chart was phased during 2010 and by the start of 2011 the printed pre-printed charted would have been used in all patients immediately following CABG surgery. The chart included aspirin, metoprolol, and atorvastatin, consistent with current recommendations for secondary prevention after CABG surgery. (4) It also included other medications commonly prescribed immediately after cardiac surgery. The intention of the pre-printed chart was to be a reminder to the treating clinicians. Although the medicines were pre-printed on the chart, there was a blank space for the dose, date, frequency, and prescriber's signature. The decision to prescribe was at the individual clinician's discretion.

Study endpoints

The primary outcome variable was the proportion of patients prescribed appropriate secondary prevention at hospital discharge. This was defined as prescription of aspirin (unless prescribed clopidogrel or warfarin), a beta-blocker, and a statin. If a patient had a contraindication to a medicine then prescribing was still considered to be appropriate even if the particular medicine was not administered. A contraindication was defined as: documented specific drug allergy, history of asthma with respect to beta-blockers, history of myopathy with respect to statins, or history of intracranial haemorrhage with respect to aspirin. Secondary outcomes included the proportion of patients receiving each of: aspirin, a beta-blocker, or a statin individually.

The dataset also described prescription, or not, of ACE inhibitors in each of the study periods although these agents were not included on the pre-printed chart.

Data collection

Patient demographics, medical history, and other medication use were collected from the admission notes, clinic records, and discharge documents. Patients who died in hospital were excluded from the analysis of the primary and secondary end points.

Sample size

In order to show a change in the proportion of patients prescribed secondary prevention at hospital discharge from 90% to 96% with a power of 0.90 and type 1 error rate of 0.05, we needed to study a total of 756 patients.

Statistics

Univariate logistic regression was used to estimate the association between year of ICU admission and the appropriate prescription of aspirin, a beta-blocker, and a statin at hospital discharge. This was repeated for each of these agents separately, and to evaluate the association with the use of an ACE inhibitor. Multivariate logistic regression was used to evaluate the strength of these associations with year of prescribing after adjustment for confounding variables. The variables included in the multivariate logistic regression were: age, sex, ethnicity (European versus non-European), peripheral vascular or cerebrovascular disease, diabetes, COPD or asthma, left ventricular ejection fraction (treated as an ordinal variable with three levels: <30%, 30-50%, and >50%), CABG only versus CABG plus valve replacement, and emergency versus elective procedure.

Data analysis was performed using SAS version 9.2 (SAS Institute, Cary, NC).

Results

During the study 746 patients underwent CABG surgery. Eighteen were excluded of whom 17 died before discharge and one patient had incomplete discharge information. Seven hudred twenty-eight patients were included in the analysis of whom 371 were admitted in 2009 and 357 were admitted in 2011.

Baseline characteristics

There were a number of important differences in the baseline characteristics between study groups (**Table 1**). In-hospital mortality for CABG patients was 2.1% before and 2.4% after chart introduction.

Discharge medications

Table 2 shows the proportions of patients prescribed agents overall and individually together with the adjusted multi-variate odds ratio (OR) for association. Prescribing of appropriate secondary prevention increased from 81.1% to 92.7% following the introduction of the chart, adjusted OR 2.63 (1.53 to 4.50), p<0.001. The association between year of prescription and overall prescribing was mainly due to an increase in the prescription of beta-blockers. Despite not being included on the pre-printed chart, the use of ACE inhibitors increased significantly.

Discussion

Statement of principal findings

In this study we show an association between introduction of a pre-printed ICU chart and an increase in the rate of prescription of secondary prevention medications at hospital discharge among post-CABG patients. To our knowledge, this is the first study assessing the effect of a quality improvement strategy implemented in the ICU designed to increase the rate of guideline-appropriate prescribing at hospital discharge.

Relationship to previous studies

In this study, the rates of prescription of secondary prevention medications at hospital discharge post-CABG, even prior to the pre-printed drug chart intervention, were higher than those observed in previous studies. (6-8) Despite our high baseline rate of prescribing, we were still able to show that the use of a pre-printed ICU drug chart was associated an increase in the prescribing rate. Pre-printed medication charts are simple, cheap, and easy to implement. (9) They have previously been shown to increase the rates of prescribing of prophylactic enoxaparin. (9)

Although the use of pre-printed ICU cardiac medication charts after cardiac surgery has not been evaluated previously, a number of other strategies have proven effective in improving rates of secondary prevention in hospitalized patients with ischaemic heart disease. These include the introduction of protocols, (10) the use of computerized alerts directed to a hospital pharmacist by identifying troponin positive patients, (11) and the use of a multidisciplinary team dedicated to improving secondary prevention following CABG surgery. (12)

The largest study designed to improve secondary prevention following CABG surgery was a cluster trial involving 458 hospitals treating 361,328 patients. (13) This study showed that a quality improvement initiative consisting of low intensity clinician educational interventions, site-specific feedback and a discharge check-list could improve the rates of prescription of secondary prevention medications. (13)

A systematic review of randomized controlled trials of interventions designed to improve secondary prevention in coronary artery disease patients showed that such interventions are usually effective. (14) Interestingly, although most studies were directed at improving the rates of statin prescribing, they often led to increases in the prescription of beta blockers and antiplatelet drugs as well. (14) In our study, the use of ACE inhibitors increased despite the fact that they were not included on the pre-printed chart. Although ACE inhibitors are administered for a range of indications, it is possible that the increase in prescription rates occurred as a consequence of an increased awareness of secondary prevention instilled through the introduction of the chart. On the other hand, it could be that the increase in prescribing of ACE inhibitors occurred as part of a general improvement in secondary prevention over time which was independent of the study intervention. Improvements in secondary prevention measures after CABG surgery over time in the absence of specific interventions have been observed previously. (13,15)

Limitations

Our study used a before and after design so we cannot rule out a simple temporal effect on prescribing rates. However, causality is supported by the strength of association between the intervention and improved rates of prescribing of appropriate secondary prevention persisting after adjustment for potential confounding variables. Although ICU patients were identified prospectively, some of our data collection required retrospective review of charts which may have led to bias as those collecting the data were aware of the study hypothesis. In addition, we did not assess whether the increase in the prescription of secondary prevention medications was sustained after hospital discharge or the pre-operative use of medications.

Conclusions

Overall, we have demonstrated that introduction of a pre-printed ICU cardiac drug chart was associated with an increase in the rates of prescribing of secondary prevention on hospital discharge post-CABG. However, we cannot exclude a simple temporary effect on prescribing rates. The use of a low cost pre-printed ICU drug chart may increase rates of prescription of appropriate secondary prevention at hospital discharge. This in turn should improve clinical outcomes in post-CABG surgery patients. (5)

Table 1. Baseline characteristics of patients undergoing CABG in the year before and the year after the introduction of the pre-printed ICU cardiac medication chart

	Pre-intervention (n=371)	Post-intervention (n=357)
Demographics		
• Age (years): Mean (SD)	65.3 (10.1)	67.1 (9.9)
• Sex: Male [n (%)]	278 (74.9)	304 (85.2)
• Ethnicity [n (%)]:		
○ European	311 (83.8)	303 (84.9)
○ Non European	60 (16.2)	54 (15.1)
Co-morbidities [n (%)]		
• Extracardiac arteriopathy	61 (16.0)	86 (24.1)
• Diabetes	91 (24.0)	95 (26.6)
• Current smoker	64 (17.2)	37 (10.4)
• Previous CABG	7 (1.9)	8 (2.2)
• Previous stenting	22 (5.9)	45 (12.6)
LVEF category* [n (%)]		
• <30%	13 (3.6)	13 (4.5)
• 30-50%	70 (19.2)	78 (26.7)
• >50%	202 (77.3)	201 (68.8)
Surgical details [n (%)]		
• CABG only	282 (76.0)	295 (82.9)
• CABG+valve	89 (24.0)	65 (18.2)
• Elective	328 (88.4)	323 (90.5)
• Emergency	43 (11.6)	34 (9.5)

Legend: SD=Standard deviation; CABG=Coronary artery bypass graft; LVEF=Left ventricular ejection fraction; *=LVEF data were only available for 365 patients in the pre-intervention group and 292 patients in the post-intervention group

Table 2. Comparison of the hospital-discharge prescribing rates for secondary prevention cardiovascular medications before and after the introduction of the pre-printed medication chart

	Pre-intervention (n=371)	Post-intervention (n=357)	OR (95% CI), p
Medication [n (%)]			
• All (aspirin, beta blocker, statin)	301 (81.1)	331 (92.7)	2.63 (1.53 to 4.50), <0.001
• Aspirin	366 (98.7)	351 (98.3)	0.95 (0.21 to 4.22), 0.94
• Beta blocker	320 (86.3)	347 (97.2)	5.06 (2.30 to 11.1), <0.001
• Statin	348 (93.8)	345 (96.6)	1.41 (0.65 to 3.05), 0.38
• ACE inhibitor	101 (27.2)	146 (41.0)	1.69 (1.20 to 2.40), 0.003

Legend: OR=Odds ratio adjusted for confounding variables; CI=Confidence interval

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