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International Journal of Collaborative Research on Internal Medicine & Public Health
Vol. 4 No. 1 (January 2012)
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ABSTRACT

Introduction: Traditionally, Percutaneous Coronary Intervention (PCI) has been performed as an inpatient procedure followed by a hospital stay up to several days. With the advent of newer therapies, PCI is routinely requiring less hospital stay following the procedure. With the ever-increasing cost of healthcare and advancement in PCI, same-day discharge for low-risk patients could become the mainstay of therapy.

Methods: A retrospective chart review was conducted of patients who underwent PCI between 2008 and 2009 and had same day discharge at Providence Hospital. The parameters studied included patient’s comorbidities, access site, vessels involved, anti-coagulation used, and any complications following discharge.

Results: Seventeen patients met the criteria. Mean age of patients was 62±11 years. 90% of patients had stable angina and underwent elective procedures. Access site was obtained via femoral route in all of the patients with sixteen having a closure device. 80% of patients had a stent placement while the rest underwent angioplasty without stent placement. All patients had intervention involving only a single vessel. No cardiac events including sub-acute stent thrombosis, recurrent angina, and clinically significant arrhythmia were reported within 24 hours of the procedure. One patient developed a hematoma one week following PCI, which did not necessitate hospital admission.

Conclusion: Newer advances in PCI have played a vital role in decreasing the incidence of acute complications following PCI. These advances especially when utilized with proper risk stratification through validated criteria can help identify low risk PCI patients that can be discharged safely on the same day of the procedure.

Keywords: Same day discharge, acute coronary syndromes, percutaneous coronary intervention, society for cardiovascular angiography and intervention
Introduction

Since its inception in 1977, Percutaneous Coronary Intervention (PCI) has become a cornerstone in the treatment of coronary artery disease (CAD). Traditionally, PCI has been performed as an inpatient procedure followed by a hospital stay up to several days. This prolonged hospital stay was historically influenced by multiple factors including prolonged anticoagulation regimens, larger sheath sizes, femoral access, lack of closure devices, and relatively high risk of acute closure due to angioplasty without stent placement.

With the advent of newer technologies and therapies, PCI currently requires less hospital stay following the procedure. Overnight stay is still the mainstay of therapy; however, cardiologists are increasingly opting to perform PCI as an outpatient procedure for selected patients. With the ever-increasing cost of healthcare, trends of current health policies and the advances in PCI and periprocedural care, same-day discharge for low-risk patients may become the standard of care.

Multiple procedural, technological, and pharmacological advances have decreased the length of hospital stay following PCI. Radial access and the introduction of closure devices have allowed earlier ambulation and decreased the risk of access-site complications, when compared to femoral access. Also, the use of direct thrombin inhibitors has decreased the risk of bleeding and the availability of new, more potent antiplatelet therapies has reduced rates of acute closure following stenting. The advances such as these have increasingly made same-day discharge following PCI a viable option for many patients.

Considering the lack of U.S.-based studies to support recommendations for same-day discharge following PCI, we conducted a retrospective, single-center study evaluating the safety of same-day discharge following PCI. Furthermore, we discuss our experience in relation to the proposed Society for Cardiovascular Angiography and Intervention (SCAI) classification scheme.

Methods

Study population

Upon approval from the institutional review board, a retrospective chart review was conducted of all patients who underwent PCI between 2008 and 2009 and had same-day discharge at Providence Hospital. All patients who had same-day discharge, as defined by SCAI guidelines, were included.

Seventeen patients met the criteria. Patients were evaluated for same-day discharge on an individual basis by their interventional cardiologist. The current study was designed to better define previously identified risk factors used to determine a patient’s candidacy for same-day discharge, including: age, comorbidities, renal function, vascular access site, number of stents, type of vessels involved, closure method, anti-coagulation, and presence of post-procedural complications.

Clinical Characteristics

The average age of patients was 62±11 years with strong male predominance (76%). The majority of patients had hypertension (92%) and only 3 patients (17%) had non-insulin dependent diabetes. Renal impairment, defined as creatinine clearance (CrCl) ≤ 60 ml/min calculated with Cockcroft-Gault formula, was present in 35% of the patients, with an overall cohort average of 75 ml/min (Figure1).
The majority of patients (88%) had stable angina and underwent elective procedures except for 2 patients (12%) who had unstable angina. Nearly half of all patients (52%) had a history of previous myocardial infarction (MI). The average ejection fraction (EF) for the cohort was 49±19% with only 4 patients (23%) having an EF of less than 35%. Nine patients (52%) had a history of previous revascularization procedure (Figure 2).

**PCI procedure**

**Access site and anticoagulation**

Vascular access was obtained in all patients using a 6 French (Fr) catheter introduced through the femoral artery. Sixteen patients (94%) had a closure device placed following the procedure to achieve hemostasis while only one patient had manual compression (6%).

Ten patients (59%) received clopidogrel immediately prior to the procedure, whereas 7 patients (41%) were pre-treated with clopidogrel as an outpatient. Ten patients (59%) received intravenous unfractionated heparin, with 2 patients (12%) receiving adjunctive eptifibatide, while the remaining 5 patients (29%) received bivalirudin (Figure 3).

**Procedure and Lesion characteristics**

The majority of patients (82%) underwent stent placement, of which thirteen patients (92%) received a <28mm stent. Three patients (18%) underwent balloon angioplasty alone. All patients had a single-vessel PCI. Target vessels included the left anterior descending (LAD) artery (47%), left circumflex (LCX) artery (41%), intermediate (Int) artery (6%), and right coronary artery (RCA) (6%). The average length of procedures was 75±18 minutes. Nine patients (52%) had type A class lesion according to the ACC/AHA lesion classification system. The rest (48%) had type B lesions (Figure 4).

All patients were observed for acute complications for several hours following the procedure and received teaching and discharge instructions.

**Results**

No cardiac events including sub-acute stent thrombosis, recurrent angina, clinically significant arrhythmia or death were reported within 24 hours of the procedure. All patients had a routine two week outpatient follow-up visit. One patient developed a hematoma one week following PCI, which did not necessitate hospital admission.

**Discussion**

**Supporting Evidence:**

Vascular access is a major limiting factor of early discharge following PCI. This is largely due to the amount of time required to achieve hemostasis and access-site complications, such as major bleeding. However, recent advances in this area, such as the transradial approach, and the introduction of smaller sheath sizes and closure devices, have minimized these limitations. Clinical data supports the safety and efficacy of these new advances, which may reduce the severity and frequency of access-site complications.

A meta-analysis of 12 randomized clinical trials comparing the use of transradial to that of transfemoral access for coronary procedures has demonstrated that the transradial approach was associated with significantly lower local vascular
complications, without an increase in adverse outcomes.\textsuperscript{6} Similarly, a meta-analysis conducted by Sanjit, et. al. found the transradial approach to be superior to the transfemoral approach in reducing major bleeding and ischemic events following stent placement during PCI.\textsuperscript{7} However in our study, femoral approach was elected in all patients due to the anticipated technical difficulties associated with transradial approach.

Comparable reductions in access-site complication have been associated with the introduction of smaller sheath sizes and closure devices. In the Evaluation of 7E3 for the Prevention of Ischemic Complications (EPIC) trial, 8 – 10 French (F) sheaths were used, compared to 6 – 7 F sheaths used in Evaluation of Platelet IIb/IIIa Inhibitor for Stenting (EPISTENT) trial.\textsuperscript{8, 9} Overnight sheath placement was abolished in the Evaluation in PTCA to Improve Long-term Outcome with abciximab GP IIb/IIIa blockade (EPILOG) trial.\textsuperscript{10} These changes were responsible for the reduction in major bleeding rate from nearly 6% in the earlier trials to less than 1% in the more current trials. The advent of closure devices has also played a significant role in improving clinical outcomes by achieving faster homeostasis than manual compression, and allowed for earlier mobilization and decreased length of stay following PCI.\textsuperscript{11, 12}

There have also been many innovative changes in anticoagulation therapy that has promoted earlier discharge following PCI. Prior to the EPIC trial, it was believed that high-dose anticoagulation regimens reduce the rate of acute vessel closure. However, higher adverse outcomes, such as increased bleeding rates, were observed in the EPIC trial which used 10,000 - 12,000 unit doses of heparin as compared to the current recommendation of 60 units/kg of heparin as used in the Enhanced Suppression of the Platelet IIb/IIIa Receptor with Integrisulin Therapy (ESPRIT) trial.\textsuperscript{13} Similarly, the introduction of more potent antiplatelet therapies, such as glycoprotein IIb/IIIa inhibitors and thienopyridines have reduced rates of acute vessel closure and improved overall clinical outcomes. The Controlled Abciximab and Device Investigation to Lower Late Angioplasty Complications (CADILLAC) trial illustrated that adjunctive abciximab treatment during PCI significantly enhanced 30-day survival by reducing sub-acute thrombosis.\textsuperscript{14} Moreover, the Randomized Evaluation in PCI Linking Angiomax to Reduced Clinical Events (REPLACE-2) trial demonstrated that bivalirudin was associated with significantly less bleeding in comparison to heparin during PCI.\textsuperscript{15} In this study, current recommendations of heparin dosing were followed. Moreover glycoprotein IIb/IIIa inhibitors or bivalirudin were administered in more than half of the patients, which may have decreased the risk of acute closure and risk of bleeding.

Society for Cardiovascular Angiography and Intervention (SCAI) proposed guidelines and risk stratification

It is clear from multiple previous studies that the advances in PCI and peri-procedural care have played a vital role in decreasing the incidence of acute complications following PCI. Nevertheless, proper risk stratification is crucial in identifying low-risk patients appropriate for same-day discharge.

In April of 2009, The SCAI convened an expert panel and proposed guidelines for early discharge following PCI. These guidelines offer a plausible method for risk stratification for early-discharge following PCI based on clinical, procedural, and social factors. However, these guidelines are based largely on studies conducted in other countries with different practice patterns than the United States.\textsuperscript{4}
The classification scheme by SCAI was developed to help facilities allocate patients to their appropriate level of care following PCI. According to SCAI classification, patients are divided into four main levels of care based on length of stay: same-day discharge, observation (< 24 hours), extended observation (> 24 hours), and inpatient admission. Same-day discharge is defined by SCAI as discharge to home or other non-medical facility within the same working day.

Clinical, procedural, and social factors influence the assignment of patients to their corresponding level of care based on the SCAI’s scheme. Clinical inclusion criteria for same day discharge included stable angina on presentation, asymptomatic patients with abnormal stress test, thienopyridine use, lack of significant comorbidities, normal renal function and near normal left ventricular ejection fraction (LVEF). Procedural factors included single vessel PCI with a <28mm stent, no balloon angioplasty alone, successful uncomplicated procedure without acute closure or vessel dissection and immediate access site stabilization. Social factors included availability of appropriate home support and rapid access to a health care facility.

**Study Summation**

Newer clinical therapies and peri-procedural care have decreased the length of stay required following PCI. Improvements in vascular access and the use of closure devices has reduced the risk of major bleeding, led to faster hemostasis and earlier mobilization. Enhanced procedural techniques and anticoagulation regimens have helped to decrease the incidence of sub-acute thrombosis and bleeding rates. Despite these advances, early discharge following PCI requires proper risk stratification and validated criteria are needed.

The guidelines proposed by SCAI in their consensus document emphasize the importance of risk stratification in allocating patients to their appropriate level of care, and subsequent length of stay. Multiple clinical, procedural, and social factors are included in the proposed classification system for the management of patients following PCI. The foundation of this classification was based on reported experiences in other countries and the practice patterns in the United States.

In our retrospective study same day discharge resulted in good outcomes. Only one patient developed an adverse event, an access-site hematoma, one week following PCI which did not appear to be related to early discharge and did not require hospital admission. None of the patients in our study developed major cardiovascular events or required revascularization within 24 hours of discharge.

Most of the patients in our study met the following SCAI’s proposed inclusion criteria for same-day discharge: stable angina, near normal EF, and received thienopyridine. None of the patients had insulin-dependent diabetes, which is consistent with the proposed SCAI inclusion criteria. Moreover, patients also met other SCAI inclusion recommendations such as: single-vessel PCI, stent placement with a < 28 mm stent, no acute closure or vessel dissections, immediate stabilization of vascular access, and appropriate home support.

Our study population did deviate from the proposed SCAI criteria in the following areas. Nearly half of our patients had a history of previous MI or had previously undergone a revascularization procedure. The average patient’s CrCl was 75 ml/min with 35% of patients having stage III chronic kidney
More than 90% of patients had hypertension and two patients underwent balloon angioplasty alone. Five patients (29%) were above 70 years of age. Despite the presence of these contradictions to same-day discharge according to the SCAI criteria, these patients were discharged safely with no major complications reported within 24 hours of discharge. Moreover a recent study conducted by Ranchord, et al. did show that same day discharge in elderly population over the age of 75, who would have been excluded under SCAI classification, was safe and feasible.

Study Limitations

Some of the study limitations included sample size and study type. More than 800 charts have been reviewed; nevertheless only seventeen patients met our criteria. This may reflect the ambiguity cardiologist feel regarding same day discharge, and ascertain the need for a validated risk stratification system. Moreover, due to retrospective nature of the study, a large sample size is needed to avoid selection bias. This would not be feasible since same day discharge after PCI remain a seldom practice in the U.S.

Conclusion

A prolonged hospital stay following Percutaneous Coronary Intervention may no longer be necessary due to the advent of newer therapies. However, a validated risk stratification criteria is needed in order to safely assess whether or not a patient is a candidate for same-day discharge following PCI. Increasing healthcare costs and risks associated with prolonged hospitalization justify the need for new treatment algorithms in order to decrease hospitalization. Multiple procedural, technological, and pharmacological advances have decreased the rates of major complication and facilitated earlier discharge following PCI.

Society for Cardiovascular Angiography and Intervention’s proposed classification system offers some guidance regarding appropriateness of early discharge of selected patients. However, some of the exclusion criteria in the SCAI guidelines did not lead to adverse outcomes in our study.

There is currently no validated risk stratification system for assessing the appropriateness of same-day discharge following PCI, hence the need for large, multi-center, U.S.-based studies to develop a valid criteria. Until more data is available, the decision of same-day discharge following PCI must be an independent decision made by the physician, based on an evaluation of each individual patient.

Conflict of interest
None to declare

References


16. Ranchord AM, Prasad S, Seneviratne SK, et al. Same-Day Discharge is Feasible and

**Figure 1:** Clinical characteristics of patient population. DM: Diabetes Mellitus, GFR: Glomerular Filtration Rate, HTN: Hypertension

**Figure 2:** Clinical characteristics of patient population. pMI: Previous Myocardial Infarction, pRev: Previous Revascularization, EF: Ejection Fraction
Figure 3: Procedure characteristics: Access site and anticoagulation. CD: Closure Device, PCI: Percutaneous Coronary Intervention.

Figure 4: Procedure characteristics and Lesion Type. PCI: Percutaneous Coronary Intervention, LAD: Left Anterior Descending artery, LCX: Left Circumflex artery, Int: Intermediate artery, RCA: Right Coronary Artery, A: lesion type A, B: Lesion type B.