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Association Between Periprocedural Bleeding and Long-Term Outcomes Following Percutaneous Coronary Intervention in Older Patients

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Objectives The authors sought to describe the association between post-procedural bleeding and long-term recurrent bleeding, major adverse cardiac events (MACE), and mortality among older patients undergoing percutaneous coronary intervention (PCI).

Background Bleeding complications after PCI are associated with an increased risk for acute morbidity and long-term mortality, but the association of these bleeding complications with other events is unknown.

Methods Patients entered into the National Cardiovascular Data Registry (NCDR) CathPCI Registry (n = 461,311; 946 sites) from January 2004 to December 2008 were linked with claims from the Centers for Medicare & Medicaid Services and grouped according to in-hospital post-PCI bleeding. The association between post-PCI bleeding and 1-, 12-, and 30-month readmission for bleeding, MACE, and all-cause mortality was examined with Cox regression that included patient and procedural characteristics using no bleeding as the reference.

Results Overall, 3.1% (n = 14,107) of patients experienced post-PCI bleeding. Patients who bled were older, more often female, had more medical comorbidities, less often received bivalirudin, and more often underwent PCI via the femoral approach. After adjustment, bleeding after the index procedure was significantly associated with readmission for bleeding (adjusted hazard ratios [95% confidence interval]: 1 month, 1.54 [1.42 to 1.67]; 12 months, 1.52 [1.40 to 1.66]; 30 months, 1.29 [1.11 to 1.50]), MACE (1 month, 1.11 [1.07 to 1.15]; 12 months, 1.17 [1.13 to 1.21]; 30 months, 1.12 [1.06 to 1.19]) and all-cause mortality (1 month, 1.32 [1.26 to 1.38]; 12 months, 1.33 [1.27 to 1.40]); 30 months, 1.22 [1.15 to 1.30]).

Conclusions Post-PCI bleeding complications are associated with an increased risk for short- and long-term recurrent bleeding, MACE, and all-cause mortality. These data underscore the prognostic importance of periprocedural bleeding and the need for identifying strategies to reduce long-term bleeding risk among patients undergoing PCI. (J Am Coll Cardiol Intv 2012;5:958–65) © 2012 by the American College of Cardiology Foundation

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Bleeding complications that occur after percutaneous coronary intervention (PCI) are associated with an increased risk for morbidity and all-cause mortality (1). Mechanisms underlying this association are unclear but likely include cessation of evidence-based medical therapy (2); blood transfusion (1); the effect of comorbidities among patients who develop bleeding (3); or the effect of bleeding itself when bleeding is intracranial or retroperitoneal. Despite the lack of clarity on the pathophysiological explanations, the adverse prognostic impact of bleeding has been noted in the outpatient setting as well, with up to 11% of patients discontinuing at least 1 antiplatelet agent due to so-called "nuisance" bleeding (4). Identification of patients at high bleeding risk has been proposed as a way to selectively implement "bleeding avoidance strategies" (5,6).

Most studies examining the prognostic impact of bleeding have examined outcomes associated with either in-hospital (5) or out-of-hospital bleeding (7), but not both. In addition, these studies have primarily examined mortality or ischemic events as the outcome; few studies have assessed the relationship between acute bleeding and both recurrent bleeding and ischemic events that occur over the long term. It remains unclear whether patients who develop hemorrhagic complications after PCI continue to be at risk for bleeding complications long after the procedure. This is an important issue, given the need for prolonged antithrombotic therapy for secondary prevention (8,9) and the differential bleeding profiles of various evidence-based discharge antithrombotic therapies. Accordingly, we used a large contemporary registry of patients undergoing PCI to examine the association between post-PCI bleeding and long-term outcomes, including readmission for bleeding events.

Methods

Patient population. The National Cardiovascular Data Registry (NCDR) CathPCI Registry, which is cosponsored by the American College of Cardiology and the Society for Cardiovascular Angiography and Interventions, has been previously described (10). The CathPCI Registry collects data on patient and hospital characteristics, clinical presentation, treatments, and outcomes for PCI procedures from over 1,000 sites across the United States. Data are entered into NCDR-certified software at participating institutions, and exported in a standard format to the American College of Cardiology. There is a comprehensive data quality program, including both data quality report specifications for data capture and transmission, and an auditing program. A committee of the American College of Cardiology prospectively defined the variables, which are available at the NCDR website.

For the purpose of this analysis, we included the first PCI procedure performed in any individual patient during a qualifying hospitalization between January 2004 and December 2008. The dataset comprised 1,725,600 admissions from 967 sites. Patients who died during hospitalization (n = 22,029) and patients for whom bleeding data were missing (n = 61; 1 site) were excluded. The study was approved by the institutional review board of Duke University Medical Center, which determined that the study met the definition of research not requiring informed consent.

Linkage to claims data. The CathPCI Registry only contains data on in-hospital outcomes. In order to determine the association between in-hospital bleeding complications and longer-term outcomes, we linked CathPCI Registry patients over the age of 65 years with the Medicare 100% Part A claims file (11). Percutaneous coronary intervention procedure codes (International Classification of Diseases-Ninth Revision-Clinical Modification [ICD-9-CM], 00.66, 36.0x, 37.22, 37.23, and 88.5x, except 88.59) were used to identify index procedures in the Medicare files, which were then linked to the CathPCI Registry using indirect identifiers (non-unique fields that when used in combination may identify unique hospitalizations). Linking rules used a hierarchy of evidence approach such that rules with the greatest specificity were applied first. Once a match was achieved for a patient, no further rules were applied. The linking rules contained combinations of information denoting the index PCI procedure site, patient date of birth or age, admission, discharge date, and sex. If a single CathPCI Registry record matched with multiple Medicare records using the same rules, then no linking occurred. Unidentified longitudinal profiles were obtained with up to 30 months of patient follow-up. Sites that did not match to Medicare records and patients whose index PCI procedure did not occur during a period of fee-for-service enrollment were excluded. This study included all Medicare-linked patients ≥65 years of age undergoing PCI who were enrolled in the CathPCI Registry from January 1, 2004, to December 31, 2008.

Abbreviations and Acronyms

MACE = major adverse cardiac event(s)

MI = myocardial infarction

PCI = percutaneous coronary intervention

STEMI = ST-segment elevation myocardial infarction

Endpoints and definitions. The outcomes for this analysis were readmission for bleeding, major adverse cardiac events (MACE) (defined as the composite of death, myocardial infarction [MI], or revascularization), and all-cause mortality. Outcomes were evaluated at 1 month, 12 months, and 30 months. We also examined the use of evidence-based medications at hospital discharge (defined as the prescription of aspirin, clopidogrel, beta-blockers, statins, and angiotensin-converting enzyme inhibitors) between patients who bled versus those who did not, and compared length of stay between the 2 groups.