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Diabetes complications and adverse health outcomes after coronary revascularization

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ABSTRACT

Aims: To examine effects of diabetes complications on health outcomes following coronary artery bypass graft (CABG) and percutaneous coronary intervention (PCI), comparing outcomes for patients with diabetes complications to those without diabetes complications.
Methods: Retrospective analysis of discharge data for 61,566 patients with diabetes age 45 or older who had CABG or PCI in 2007 in United States community hospitals, using data from the Nationwide Inpatient Sample. Analysis included propensity score-adjusted logistic regression.
Results: Of all patients, 21.2% of the weighted sample had diabetes complications. Older patients, Blacks and Hispanics, and those with greater illness severity were more likely to have diabetes complications. Unadjusted rates of in-hospital mortality, postoperative stroke, and renal failure were higher for patients with diabetes complications (rate ratios 2.2, 1.8, and 9.8, respectively; all $p < 0.0001$). In adjusted results, having diabetes complications was associated with higher odds of in-hospital mortality (odds ratio, OR 1.62, 95% confidence interval, CI 1.37–1.91) and renal failure (OR 3.03, CI 1.71–5.39). Compared to CABG, PCI was associated with extra risk of postoperative renal failure for those with diabetes complications.
Conclusion: Among patients with diabetes having revascularization, those with diabetes complications have higher risks of in-hospital death and renal failure irrespective of having CABG or PCI.

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1. Introduction

Individuals with coronary artery disease (CAD) often have diabetes, which increases the cost and health care burden of CAD [1]. Diabetes is a major risk factor for CAD, accelerates CAD progression, and is an indicator of worse outcomes after medical procedures [2]. People with diabetes are likely to have more coronary calcification than others [3], which is a marker for heart attack and coronary death [4]. Although recent technological advances in percutaneous coronary intervention (PCI) have increased its use for high-risk patients [5,6], with benefits comparable to coronary artery bypass graft (CABG), the procedures are not equally optimal for all patients [6,7]. There are subgroups of patients for whom the optimal revascularization technique is less clear. For example, studies that include patients with diabetes often lack information about the presence of diabetes complications; thus, few

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studies have examined the effectiveness of PCI and CABG in patients with diabetes complications [8].

Some physicians believe CABG may be more appropriate than PCI for patients with severe CAD and comorbid diabetes [9]. However, guidelines to evaluate the comparative effectiveness of CABG and PCI were developed with clinical evidence from studies with patients who may not represent the US general population [10,11]. Further, a review of randomized clinical trials and registry revascularization studies that included patients with diabetes has identified limitations, including small samples of individuals with diabetes, and lack of information about glycemic control or complications of diabetes [8]. To address these limitations, administrative data is increasingly used in outcomes research because it is readily available, and because it includes information on large numbers of hospital discharges, which is needed to conduct statistically meaningful subgroup analysis [12–16].

No studies have used nationally representative data to examine short term outcomes following CABG and PCI among patients with diabetes. No research of patients with diabetes has examined outcomes following CABG or PCI focused on whether or not the patient had diabetes complications. A better understanding of outcomes associated with diabetes complications, for these relatively common procedures, can help to inform health care providers about clinical characteristics that increase the risk of poorer outcomes following revascularization. Depending on the results, providers may want to give more attention to one or both of these surgical groups to reduce the risk of poor outcomes, or to identify and address declining health status when it first develops. If those with diabetes complications have greater risk of poor outcomes following revascularization than previous research using smaller samples suggest, researchers may then want to develop and test interventions for these patients. Comorbid diabetes complications, rather than diabetes itself, may explain higher risks for adverse outcomes, suggesting ways to improve care quality and medical management for these patients before and after coronary revascularization. Identifying patient demographic and clinical characteristics associated with adverse outcomes may also help to select patients best served with either CABG or PCI [9].

Thus, the purpose of this study is to examine associations between diabetes complications among patients having CABG or PCI and three adverse outcomes: in-hospital mortality, postoperative stroke, and renal failure. We hypothesize that, among patients with diabetes, those with diabetes complications will be more likely to have one or more of these adverse short-term health outcomes following CABG or PCI. As small vessel size and contrast-induced nephropathy are risk factors for worse outcomes in PCI, we also expect that short-term adverse health outcomes for patients with diabetes complications will be less likely for those having CABG than for those having PCI.

2. Methods

2.1. Data source

This cross-sectional analysis used the 2007 Nationwide Inpatient Sample (NIS), a hospital discharge dataset from the Healthcare Cost and Utilization Project (HCUP) of the Agency for Healthcare Research and Quality (AHRQ). The NIS represents all inpatient stays in a 20% sample of United States community hospitals [17]. The NIS includes information about demographics, admission, length of stay, payer, disease severity and comorbidities, procedures, and diagnoses. It also includes information about participating hospitals: location, ownership, bed size, staffing ratio, and teaching status. This study was approved by the Institutional Review Board of the University of North Carolina at Charlotte.

2.2. Study sample

The study sample represents patients age 45 and older with diabetes who had CABG or PCI in 2007. The sample was restricted to patients age 45 and older because the use of PCI and CABG and the risks for adverse outcomes after revascularization are associated with increasing age. Further, about 97% of all those having CABG and 95% of all those having PCI in 2007 were age 45 and older [18]. Patients were included if their discharge record had one of the following International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedure codes: 36.10–36.19, 00.66, and 36.01, 36.02, 36.05–36.07, together with any diagnosis code indicating diabetes. Patients were considered to have a complication of diabetes if they had one or more of the following conditions or complications: comorbid diabetes with renal, ophthalmic, or neurological manifestations; diabetes with peripheral circulatory disorders; uncontrolled diabetes; chronic kidney disease; or renal failure. Of more than 8 million hospital discharge records in the 2007 NIS, 62,101 met the selection criteria. The sample further excluded 535 patients having both CABG and PCI. The final analytical sample had 61,566 discharge records.

2.3. Outcome and exposure variables

In-hospital mortality was defined as death occurring during hospitalization. Patients who had postoperative stroke were identified by the presence of any of the following diagnosis codes as a secondary diagnosis: 43,881–43,882, 43,889, 4389, 4380, 43,850–43,853, 43,830–43,832, 43,840–43,842, 43,820–43,822, 43,810–43,812, 43,819, 99,702 [14]. Postoperative renal failure was defined as acute renal failure requiring hemodialysis and was identified by the presence of any diagnoses for acute renal failure (584, 5840, 5845–5849), and procedure code 3995 for hemodialysis. The exposure variable, or independent variable of primary interest, was having a record of diabetes complications during the hospitalization. A detailed description of the ICD-9 diagnosis codes used to identify the outcomes and explanatory variables is shown in Appendix 1.

Supplementary material related to this article can be found, in the online version, at http://dx.doi.org/10.1016/j.diabres.2013.09.019.

2.4. Covariates

We used the Process, Structures and Outcomes of Care in Cardiac Surgery (PSOCS) framework, developed by Shroyer and colleagues [19] to guide the selection of control variables. Patient risk factors included demographic characteristics (e.g.,