JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
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PUBLISHED BY ELSEVIER INC.

VOL. 64, NO. 8, 2014
ISSN 0735-1097/$36.00
http://dx.doi.org/10.1016/j.jacc.2014.05.040

Blood Transfusion During Acute Myocardial Infarction

Association With Mortality and Variability Across Hospitals

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ABSTRACT

BACKGROUND Blood transfusion is controversial for anemic patients with acute myocardial infarction (AMI), with some previous studies reporting increased risk of transfusion-associated mortality.

OBJECTIVES The goal of this study was to examine variability in blood transfusions across hospitals and the relationship between blood transfusion and in-hospital mortality in a large, contemporary cohort of consecutive AMI patients.

METHODS Among 34,937 AMI hospitalizations from 57 centers, patients receiving at least 1 packed red blood cell transfusion were compared with those who were not transfused. Using 45 disease severity, comorbidity, laboratory, and in-hospital treatment variables, we propensity matched patients who did and did not receive a packed red blood cell transfusion. A conditional logistic regression model was used to identify the association between transfusion and in-hospital mortality.

RESULTS A total of 1,778 patients (5.1%) had at least 1 transfusion. In unadjusted analyses, transfusion was associated with higher in-hospital mortality (odds ratio: 2.05 [95% confidence interval: 1.76 to 2.40]). The vast majority of patients (91.1%) with and without transfusion had nonoverlapping propensity scores, reflecting incomparable clinical profiles. Thus, they were excluded from the propensity-matched analyses. After propensity matching those with overlapping scores, blood transfusion was associated with a reduced risk of in-hospital death (odds ratio: 0.73 [95% confidence interval: 0.58 to 0.92]).

CONCLUSIONS The majority of patients undergoing blood transfusion in clinical practice cannot be matched with nontransfused patients due to their markedly different clinical profiles. Among comparable patients, blood transfusion was associated with a lower risk of in-hospital mortality. These findings suggest that previous observational reports of increased mortality with transfusion may have been influenced by selection bias, and they highlight the need for randomized trials to establish the role of transfusion during AMI. (J Am Coll Cardiol 2014;64:811–9) © 2014 by the American College of Cardiology Foundation.

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ABBREVIATIONS AND ACRONYMS

AMI = acute myocardial infarction

CI = confidence interval

ICD-9-CM = International Classification of Diseases-Ninth Revision-Clinical Modification

IQR = interquartile range

MI = myocardial infarction

OR = odds ratio

Anemia is common at the time of acute myocardial infarction (AMI) and has been shown to portend a poor prognosis, including greater short-term and long-term mortality (1–4). In the setting of AMI, administration of packed red blood cells may augment hemoglobin levels and improve myocardial oxygen delivery, but it also carries risks, including volume overload, increased thrombogenicity, impaired oxygen delivery, and a risk of infection (5,6). Despite the widespread use of blood transfusions in clinical practice, the safety and efficacy of this method have not been evaluated in large, randomized clinical trials. Accordingly, the use of blood transfusion in AMI patients remains controversial, with some observational studies suggesting benefit in patients with low nadir hemoglobin values (1,7,8), whereas others have reported increased mortality (9–11).

SEE PAGE 820

A major challenge in the interpretation of transfusion and outcomes in observational studies is the impact of confounding. Clinicians select treatments, such as transfusion, after considering a broad array of factors, including the perceived benefits and risks for each individual patient. In such cases, observational studies may yield a relationship between treatment and outcome that primarily reflects the underlying high-risk characteristics of treated patients. Although confounding can be minimized by the use of instrumental variables or propensity matching (12), these methods have not been uniformly used in previous research.

To further illuminate the association between transfusion and survival in anemic AMI patients, we used the Cerner Health Facts database (13,14), which collects data through the electronic medical record on consecutive AMI patients at 57 U.S. hospitals. Given the large size of the patient population and the detailed collection of in-hospital laboratory, treatment, and complication data, we were able to conduct a propensity-matched analysis to specifically focus on the patients eligible for transfusion. Importantly, some patients have such life-threatening anemia that they would always be transfused, while other, "healthier" patients would rarely receive a transfusion; inclusion of such patients could lead to substantial selection bias. Finally, given the diverse collection of hospitals participating in Health Facts, we were able to examine the variability in blood transfusion practices across institutions in real-world practice.

METHODS

Health Facts captured de-identified data from the Cerner electronic medical record for patients admitted to participating hospitals between January 1, 2000, and December 31, 2008. Data collected included patients' demographic characteristics, medical history, and comorbidities (using the International Classification of Diseases-Ninth Revision-Clinical Modification [ICD-9-CM], codes), laboratory studies, medications, procedures, and complications. A total of 78 hospitals contributed data to Health Facts. The median number of AMI patients from each hospital was 219 (interquartile range [IQR]: 48 to 1,030), and the median duration of hospitals' participation was 2.9 years (IQR: 1.2 to 5.3 years). All data were de-identified before being provided to the investigators, and the institutional review board of Saint Luke's Hospital provided an exemption to review.

We included all patients hospitalized with a primary discharge diagnosis of AMI as determined by using ICD-9-CM diagnostic codes 410.xx, and AMI was further confirmed by requiring that patients have at least 1 elevated cardiac biomarker (troponin or creatine kinase-myocardial band). Patients known to be transferred from other hospitals (full laboratory testing data may not be available) or from hospice (goals of care differ from the overall population) were excluded. Inclusion and exclusion criteria are listed in detail in **Figure 1**. Important exclusions were patients admitted from hospitals contributing <20 patients to Health Facts, those with very long lengths of stay (>31 days), and patients who underwent coronary bypass grafting, valve replacement, or valve repair during hospitalization. Patients without a

Association (11GRNT7330005), Gilead Sciences (IN-US-259-0159) (with Dr. Spertus), Genentech, Sanofi-Aventis, Medtronic Diabetes, Glumetrics, Maquet, and Eisai; and has served as a consultant or on the advisory board of Gilead Sciences, Genentech, Hoffmann-La Roche, Medtronic Diabetes, AstraZeneca, AbbVie, Regeneron, Edwards Lifesciences, ZS Pharma, and Eli Lilly. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.
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Manuscript received January 6, 2014; revised manuscript received April 10, 2014, accepted May 1, 2014.