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Blood Transfusion After Percutaneous Coronary Intervention and Risk of Subsequent Adverse Outcomes

A Systematic Review and Meta-Analysis

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ABSTRACT

OBJECTIVES This study sought to define the prevalence and prognostic impact of blood transfusions in contemporary percutaneous coronary intervention (PCI) practice.

BACKGROUND Although the presence of anemia is associated with adverse outcomes in patients undergoing PCI, the optimal use of blood products in patients undergoing PCI remains controversial.

METHODS A search of EMBASE and MEDLINE was conducted to identify PCI studies that evaluated blood transfusions and their association with major adverse cardiac events (MACE) and mortality. Two independent reviewers screened the studies for inclusion, and data were extracted from relevant studies. Random effects meta-analysis was used to estimate the risk of adverse outcomes with blood transfusions. Statistical heterogeneity was assessed by considering the I^2 statistic.

RESULTS Nineteen studies that included 2,258,711 patients with more than 54,000 transfusion events were identified (prevalence of blood transfusion 2.3%). Crude mortality rate was 6,435 of 50,979 (12.6%, 8 studies) in patients who received a blood transfusion and 27,061 of 2,266,111 (1.2%, 8 studies) in the remaining patients. Crude MACE rates were 17.4% (8,439 of 48,518) in patients who had a blood transfusion and 3.1% (68,062 of 2,212,730) in the remaining cohort. Meta-analysis demonstrated that blood transfusion was independently associated with an increase in mortality (odds ratio: 3.02, 95% confidence interval: 2.16 to 4.21, $I^2 = 91\%$) and MACE (odds ratio: 3.15, 95% confidence interval: 2.59 to 3.82, $I^2 = 81\%$). Similar observations were recorded in studies that adjusted for baseline hematocrit, anemia, and bleeding.

CONCLUSIONS Blood transfusion is independently associated with increased risk of mortality and MACE events. Clinicians should minimize the risk for periprocedural transfusion by using available bleeding-avoidance strategies and avoiding liberal transfusion practices. (J Am Coll Cardiol Intv 2015;8:436–46) © 2015 by the American College of Cardiology Foundation.

Advances in antiplatelet and antithrombotic therapy have improved outcomes in patients undergoing percutaneous coronary intervention (PCI) through a reduction in ischemic events, albeit at the expense of increased risk of bleeding complications. Major bleeding observed during PCI independently predicts mortality and major adverse cardiac events (MACE), and a recent meta-analysis demonstrated an independent 3-fold increase in both mortality and MACE events following a major bleed (1). Between 2.0% and 4.0% of all patients undergoing PCI receive a blood transfusion (2–5), often

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following major bleeding events, with previous studies reporting marked variation in the use of red blood cell transfusion among patients with acute coronary syndromes (6) and in patients undergoing PCI (5). Whereas the presence of anemia is independently associated with an increase in cardiac mortality and myocardial infarction in patients with acute coronary syndromes or undergoing PCI (7,8), the optimal use of blood products in such patients remains controversial. National transfusion practice guidelines offer no recommendation for or against a liberal or restrictive transfusion threshold for such patients (9). National PCI registries have demonstrated that patients with bleeding events receive blood transfusions across the spectrum of hemoglobin values with significant variation in practice (5), and a single-center study showed that a large proportion of patients undergoing PCI received transfusion for indications outside of published guidelines (10).

SEE PAGE 447

A previous meta-analysis of 10 studies including 203,665 patients reported that blood transfusion in the setting of acute myocardial infarction is associated with a 3-fold increase in all-cause mortality and a 2-fold increase in recurrent myocardial infarction (11), although it included studies mainly of patients with acute coronary syndromes who did not undergo PCI and were managed medically, hence the applicability of the findings to patients undergoing PCI remains unclear. Defining the role of transfusion in patients undergoing PCI can inform clinical practice. There has not been a systematic review or meta-analysis of the prevalence and prognostic impact of blood transfusion in the setting of PCI. We have therefore undertaken a meta-analysis to systematically study the impact of blood transfusion in patients who have undergone PCI on mortality and MACE outcomes. In this meta-analysis, we provide an overview of the cohorts, evaluating the rates of blood transfusion events and systematically studying the differences in the prognostic impact of blood transfusion in patients undergoing PCI.

METHODS

ELIGIBILITY CRITERIA. Studies were selected of patients who underwent PCI reporting mortality or cardiovascular events among patients with and without blood transfusion with no restriction based on study design or the indication for PCI. Studies that did not report on transfusion and those that did not report either mortality or MACE were excluded.

SEARCH STRATEGY. A search of EMBASE (1974 to March 4, 2014) and MEDLINE (1946 to March 4, 2014) was conducted on OVID SP. We used the following search terms: (transfusion AND (percutaneous coronary intervention OR PCI) AND mortality). Studies in all languages and both abstracts and unpublished studies were included. The bibliographies of the included studies and relevant review articles were checked for additional relevant articles. Authors were contacted in situations in which there was uncertainty regarding the data in the studies.

ABBREVIATIONS AND ACRONYMS

CI = confidence interval

HR = hazard ratio

MACE = major adverse cardiac events

OR = odds ratio

PCI = percutaneous coronary intervention

STUDY SELECTION AND DATA EXTRACTION. Two reviewers (C.S.K. and S.W. or S.N.) independently checked all titles and abstracts for studies potentially meeting the inclusion criteria. The full reports of these studies were retrieved, and data were independently extracted on study design, participant characteristics, interventions used, type of transfusions, outcome events, and follow-up. Any discrepancies between the 2 reviewers were resolved by consensus after consulting a third reviewer (M.A.M.).

QUALITY ASSESSMENT. Risk of bias was assessed by considering ascertainment of transfusion, ascertainment of outcomes, baseline differences between the transfused and not transfused group, loss to follow-up, and use of adjustment in data analysis. Publication bias was assessed using funnel plots when there were >10 studies available in the meta-analysis and there was no evidence of substantial statistical heterogeneity (12).

DATA ANALYSIS. The program RevMan (version 5.1.7, Nordic Cochrane Centre, Copenhagen, Denmark) was used to do random effects meta-analysis using the inverse variance method for pooled odds ratios. Similarity was assumed between the odds ratio and other relative measures such as relative risk, rate ratios, or hazard ratios (HRs) because cardiovascular events and death were rare events (13). Adjusted or propensity-matched risk estimates were used where available. For datasets reporting multiple time-points, the earliest time point was included in the primary analysis. The I^2 statistic was used to assess statistical heterogeneity.

Several analyses were undertaken. The primary analysis was the risk of mortality and MACE with and without transfusion. In addition, further analysis considering adverse outcomes at a longer follow-up duration were undertaken. Additional analyses were performed to evaluate the risk of death considering anemia, the influence of number of units