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Red Blood Cell Transfusion in Patients With Traumatic Brain Injury: A Systematic Review and Meta-Analysis

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ABSTRACT

Our objectives were to evaluate the frequency of red blood cell (RBC) transfusion in patients with traumatic brain injury (TBI) as well as potential determinants and outcomes associated with RBC transfusion in this population. We conducted a systematic review of cohort studies and randomized trials of patients with TBI. We searched Medline, Embase, the Cochrane Library, and BIOSIS databases from their inception up to April 2015. We selected studies of adult patients with acute TBI reporting data on RBC transfusions. Cumulative incidences of transfusion were pooled using random-effect models with a DerSimonian approach. To evaluate the association between RBC transfusion and potential determinants or clinical outcomes, we pooled risk ratios or mean differences with random-effect models and the Mantel-Haenszel method. We identified 24 eligible studies (17 414 patients). After pooling data from 23 studies (7524 patients), approximately 36% (95% confidence interval [CI], 28–44; $I^2 = 98\%$) of patients received RBC transfusion at some point during their hospital stay. Hemoglobin thresholds for transfusion were rarely available (reported in 9 studies) and varied from 6 to 10 g/dL. Glasgow Coma Scale scores at admission were lower in patients who were transfused than those who were not (3 cohort studies; 1371 patients; mean difference of 1.38 points [95% CI, 0.86–1.89]; $I^2 = 12\%$). Mortality was not significantly different among transfused and nontransfused patients in univariate and multivariate meta-analyses. Hospital length of stay was longer among patients receiving RBC transfusion compared to those who did not (3 studies; $n = 455$; mean difference, 9.58 days [95% CI, 3.94–15.22]; $I^2 = 74\%$). Results should be considered cautiously due to the high heterogeneity and high risk of confounding from the observational nature of included studies. Red blood cell transfusion is frequent in patients with TBI, and transfusion practices varied widely between studies. Current published data highlight the lack of clinical evidence guiding transfusion strategies in TBI.

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Evidence for red blood cell (RBC) transfusions continues to be subject to discussion in critical care medicine. Despite a high incidence of anemia in patients admitted to intensive care units (ICUs) [1], guidelines remain cautious or silent regarding best transfusion practices in neurocritically ill patients [2–5]. The American College of Surgeons [6] recently recommended to maintain a hemoglobin level greater than 7 g/dL based on data from 1 recent trial [7]. Although low hemoglobin levels have been shown to be potentially harmful in many situations, correction with allogeneic RBC transfusions has also been associated with adverse clinical outcomes, such as higher mortality, infection, multiorgan dysfunction syndrome, and acute respiratory distress syndrome [8,9]. In addition, the high cost of blood products [10] further spurs rational use of this scarce resource.

Transfusion practices in the general nonbleeding medical and surgical ICU population have been extensively described [1,11] and have demonstrated that restrictive strategies (lower hemoglobin thresholds) and liberal strategies (greater hemoglobin thresholds) are generally equally safe [12–14]. However, neurocritically ill patients were under-represented in these studies, and data remain scarce regarding best transfusion practices in this population [13].

Given the vulnerability of the brain to secondary hypoxic insults, concerns have been raised regarding the safety and efficacy of restrictive transfusion strategies in acute neurologic conditions [15]. A recent systematic review of comparative studies highlighted the paucity of data regarding the adoption of liberal or restrictive strategies in this specific population [16]. At present, no consensus has still been reached on appropriate transfusion thresholds in neurocritically ill patients [7,17,18].

Considering the clinical equipoise regarding optimal transfusion strategies in the subpopulation of patients with traumatic brain injury (TBI), current practices must first be described to inform future clinical trials evaluating transfusion strategies. We aim to estimate the frequency of RBC transfusion in patients with TBI. We also seek to describe transfusion thresholds and evaluate potential determinants and outcomes associated with RBC transfusion through a systematic review of cohort studies and randomized controlled trials of patients with TBI.

Methods

We conducted a systematic review of cohort studies and randomized control trials reporting transfusions of RBC in patients with acute traumatic cerebral lesions admitted to an ICU.

Protocol and Registration

The protocol has been published previously [19]. This review has been registered in PROSPERO (www.crd.york.ac.uk/prospéro) (CRD42014007402).

Eligibility Criteria

We included prospective and retrospective cohort studies as well as randomized controlled trials of adult patients (at least 80% older than 18 years) with TBI (as reported by authors). Reported data on RBC transfusion were required for study inclusion. We contacted authors when “blood transfusions” were reported, without specification on the type of blood product or frequency of RBC transfusions.

Information Sources

We systematically searched Medline, Embase, BIOSIS, and the Cochrane Library (from their inception up to April 2015) for eligible studies. We also reviewed the references of included studies and abstracts presented at major conferences (Neurocritical Care Society, Society of Critical Care Medicine, European Society of Intensive Care Medicine Annual Congress, Society of British Neurological Surgeons, and National Neurotrauma Symposium).

Search Strategy

A team of clinicians, investigators with expertise in transfusion or neurocritical care, or both, as well as an information specialist, identified keywords and index terms related to transfusion, anemia, and TBI. Our search was limited to human studies [20]. No language or date of publication restriction was used. Our search strategy for Medline using PubMed is available in Supplementary material, Appendix A. Reference management was performed using EndNote (version X5, Thomson Reuters, 2011).

Study Selection

Two independent reviewers (AB and MS) screened all references to determine eligibility. Initially, titles and abstracts were assessed; full texts of studies still considered potentially eligible were then reviewed.

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