Determinants of transfusion decisions in a mixed medical-surgical intensive care unit

A prospective cohort study

Abstract

Background: For reasons unknown, a restrictive transfusion policy of red blood cells (RBC) is gradually implemented by ICU physicians, resulting in a large variation in transfusion practice. Insight into physician’s transfusion decisions may aid in efforts to restrict transfusion practice.

Methods: In a prospective cohort study, transfusion triggers were determined in consecutively admitted patients during a 10–week period. Using a questionnaire, the reason of ICU physicians to transfuse RBC was evaluated.

Results: Of 310 admissions, 90 patients (29%) received a RBC transfusion. 81 patients were included. RBC were transfused on a mean Hb–level of 7.4±1.1 g/dl. Residents transfused RBC on a higher Hb–level compared to staff (7.7±1.0 versus 6.9±1.3, p<0.05). The most important reason for physicians to transfuse RBC was suspicion of bleeding. Age and coronary ischemia were in 4% and 12% predominant reasons to transfuse RBC. The average order for RBC transfusion was 4 units. Of each order, 38% of the units was not administered.

Conclusions: RBC transfusion decisions are predominantly based on Hb levels rather than on patient characteristics. Residents transfuse on a higher Hb compared to more experienced physicians. The major determinant for physicians to transfuse RBC is bleeding. However, the majority of patients were transfused in the absence of bleeding, of whom a large part received multiple units. The need of RBC may be overestimated, resulting in wasted orders.
Introduction

Transfusions of red blood cells (RBC) are frequently prescribed in intensive care unit (ICU)–patients. However, transfusion of blood products may cause severe adverse events, such as infection, immunization, pulmonary edema and (transfusion–related) acute lung injury. A restrictive RBC–transfusion hemoglobin (Hb) level of 7 g/dl is well tolerated in ICU–patients and is associated with less pulmonary complications when compared to a liberal Hb trigger of 10 g/dl. A restrictive trigger for transfusion of RBC may even reduce mortality in specific patient groups. As a consequence, transfusion guidelines recommend conservative RBC–transfusion triggers. ICU–physicians have been reluctant in adopting conservative RBC–transfusion thresholds, and there is wide variation in transfusion practice of RBC.

Data on present transfusion practice in the critically ill are limited. To gain insight into transfusion practice, a prospective cohort study was performed to determine transfusion triggers for RBC. By using questionnaires, we investigated reasons why RBC are given to a cohort of critically ill patients in the Netherlands. Insight into determinants of the decision of ICU–physicians to transfuse could help to improve transfusion practice.

Methods

Setting

The study was performed in a 30–bed mixed medical–surgical ICU of a university hospital in The Netherlands. This ICU is a “closed format” department in which patients are under the direct care of the ICU–team consisting of 10 full–time intensivists, 8 subspecialty fellows and 12 residents.

Population

The population consisted of all patients on the ICU receiving a RBC transfusion ordered by an ICU–physician, from March till June 2007 (with the exception of patients receiving their first transfusion during the weekends).

Questionnaires

Questionnaires were given to ICU–physicians within 24 hours after prescribing RBC. This was done either by person or by e–mail. For patients receiving multiple transfusion episodes, only the first order of RBC was evaluated. If the ICU–physician did not respond to the questionnaire within 24 hours, it was defined as
a non-response. When a non-response occurred, the first following transfusion of RBC was taken as the first new transfusion. Physicians were questioned for the most important reason for administering RBC from a list of 9 choices: age, coronary artery disease, bleeding, hemodynamic instability, improvement of well-being, improvement of peripheral O₂ delivery, improvement of weaning, pre-operative/pre-intervention, or otherwise. When more than one unit RBC was ordered, physicians were asked to choose between expected Hb post transfusion, ongoing bleeding or pre-operative/pre-intervention as a reason to transfuse multiple units. The level of experience of the physician was recorded (staff, fellow or resident). The physicians were also asked whether the need for transfusion was noticed by him/herself or whether it was noticed by an ICU–nurse or his/her supervisor. Questionnaires were pre-tested by independent physicians on clarity of content.

Definitions
Bleeding was diagnosed if the Hb–level dropped 0.6 g/dl per hour after correction for transfusion of RBC (0.3 g/dl Hb per unit RBC transfused) combined with clinical evidence for or suspicion of bleeding (rectal blood loss, melena, blood in gastric tube, loss of blood in thoracic or abdominal drains, or hemothoe). If an ordered unit was not transfused within 2 hours after arrival it was seen as a wasted order unless the patient had died. This timeframe was chosen because in our institution, RBC can be administered within 30 minutes after ordering.

Data collected
Data on patient history, as well as hemodynamic data were prospectively collected from the electronic patient file (admission diagnosis, admission time, APACHE II score, Hb pre-transfusion).

Statistical analysis
Descriptive statistics were performed with SPSS 12.0.1. Means were compared using a Student-t test or an Anova Analysis with Dunnetts post test for normal distributed data or a Mann Witney U-test for not normal distributed data. Data are presented as means with standard deviation or mentioned otherwise.

Results
During a 10–week period, 310 ICU–admissions were screened, of which 90 (29%) patients received a RBC transfusion. From this group, data from 9 patients could not
be collected because the questionnaires were not returned within 24 hours, leaving data of 81 patients for analysis. In total 198 patients did not receive a transfusion product. Patient characteristics are shown in Table 1. RBC were transfused on a mean Hb–level of 7.4 ± 1.1 g/dl (Table 2). Pre-transfusion Hb-level did not differ between patients suspected of bleeding and non-bleeding patients. Residents transfused RBC on a higher Hb–level as compared to staff and fellows (p < 0.05).

<table>
<thead>
<tr>
<th></th>
<th>Not transfused</th>
<th>Transfused (included)</th>
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<tbody>
<tr>
<td></td>
<td>(n=198)</td>
<td>(n=81)</td>
</tr>
<tr>
<td>Age</td>
<td>60 ±15.6</td>
<td>61 ±15</td>
</tr>
<tr>
<td>Male</td>
<td>69%</td>
<td>69%</td>
</tr>
<tr>
<td>ICU stay (days)</td>
<td>1.8 [0.9-3.9]</td>
<td>2.2* [1.0-9.4]</td>
</tr>
<tr>
<td>Surgical</td>
<td>33%</td>
<td>19%</td>
</tr>
<tr>
<td>Medicine</td>
<td>34%</td>
<td>35%</td>
</tr>
<tr>
<td>Cardio-surgery</td>
<td>33%</td>
<td>46%</td>
</tr>
<tr>
<td>APACHEII score</td>
<td>16 ± 6.6</td>
<td>18* ± 7.8</td>
</tr>
</tbody>
</table>

Data show general patients characteristics of included patients receiving RBC transfusion(s) (Transfused) and patients which did not receive any transfusion (Not transfused). Data are reported as percentage (%), mean ± SD or number or median [IQR]. *P < 0.01

When asked for the reason for transfusion, physicians most often scored bleeding (Table 3). Bleeding was confirmed in 48% of patients when the definition of bleeding was used. The agreement between physicians reporting a bleeding and the definition was moderate (κ 0.41). Age and coronary artery disease were less frequent reasons for transfusion of RBC. Staff did not differ from fellows or residents in the reason to transfuse RBC. The transfusion need was in 32% of the cases pointed out by the nurse when a resident ordered the transfusion compared to 12.5% of staff members or fellows ordering a transfusion.

Of the transfused patients, 44% received more than 1 unit. The most important reason to transfuse more than 1 unit was the expected Hb–level after transfusion (Table 3). A minority of patients received multiple units because of suspicion of bleeding or for prevention of bleeding. On average 4.0 ± 4.6 units RBC were ordered, of which 1.5 ± 2.0 units (38%) were not transfused.
Table 2. Transfusion triggers

<table>
<thead>
<tr>
<th></th>
<th>Hb Trigger (g/dl)</th>
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<tbody>
<tr>
<td>Average trigger</td>
<td>7.4 ± 1.1</td>
</tr>
<tr>
<td>Residents</td>
<td>7.7 ± 1.0*</td>
</tr>
<tr>
<td>Fellow ICU</td>
<td>7.1 ± 1.2</td>
</tr>
<tr>
<td>Staff</td>
<td>6.9 ± 1.3</td>
</tr>
<tr>
<td>Bleeding</td>
<td>7.3 ± 1.0</td>
</tr>
<tr>
<td>Non-bleeding</td>
<td>7.5 ± 1.3</td>
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Hemoglobin (Hb) g/dl is reported as mean ± SD. *P<0.05 Anova analysis with Dunnett post test.

Table 3. Reasons to order a transfusion product

<table>
<thead>
<tr>
<th>Reasons to order a RBC transfusion</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding</td>
<td>36%</td>
</tr>
<tr>
<td>Improvement peripheral O2 delivery</td>
<td>19%</td>
</tr>
<tr>
<td>coronary artery disease</td>
<td>12%</td>
</tr>
<tr>
<td>Hemodynamic instability</td>
<td>10%</td>
</tr>
<tr>
<td>Age</td>
<td>4%</td>
</tr>
<tr>
<td>pre–operative/pre–intervention</td>
<td>4%</td>
</tr>
<tr>
<td>Improving general condition patient</td>
<td>6%</td>
</tr>
<tr>
<td>Other</td>
<td>9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reasons to order &gt;1 RBC transfusion</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Hb post transfusion</td>
<td>58%</td>
</tr>
<tr>
<td>Ongoing bleeding</td>
<td>33%</td>
</tr>
<tr>
<td>pre–operative/pre–intervention</td>
<td>3%</td>
</tr>
<tr>
<td>Other</td>
<td>6%</td>
</tr>
</tbody>
</table>

Discussion

In this prospective study on transfusion practice in a tertiary ICU–patient cohort, the most important reason to transfuse RBC is bleeding. However, the majority of RBC transfusions are given in the absence of bleeding. In these patients, other determinants are rarely taken into account. Transfusion of multiple units was common, also in the absence of bleeding.

Although indicative of a restrictive transfusion policy and relatively low compared to other studies, we did not find the Hb–level of 7 g/dl, reported to be safe in critically ill patients. Lowering of Hb transfusion thresholds has been reported before in the general hospital population and to a limited extent in the critically
Two large observational trials, however, report unchanged transfusion practices in the critically ill after the ‘landmark paper’ of Hebert et al. Possible explanations for the reluctance to adopt restrictive RBC transfusion may include a high prevalence of coagulation disorders in critically ill patients, together with multiple conditions which put these patients at risk of bleeding. In accordance, the major reason of physicians in our ICU to transfuse a patient with RBC was suspicion of bleeding. Of note, suspicion of bleeding was affirmed by posthoc analysis in only half of the patients. We conclude it may be hard to predict when a patient is bleeding. This may explain the high percentage of wasted RBC units per order (38%) found in this study.

The majority of the patients in our study were transfused in the absence of bleeding. Others have also reported a high number of RBC transfusions in non-bleeding ICU patients. Although the optimal Hb trigger in the critically ill is still a matter of debate, no studies underscore the benefit of RBC transfusion to treat anemia in non-bleeding critically ill patients. Other determinants of transfusion, such as the presence of coronary ischemia or age were rarely taken into account in the transfusion decision in our study. Although contradictory to international consensus guidelines, this finding is consistent with other studies. Physicians are reported to believe that patients at risk of coronary ischemia require a higher RBC transfusion trigger. However, this belief is not applied in daily practice. Results of this study confirm that transfusion decisions are predominantly based on Hb levels rather than on physiologic parameters. Undertransfusion, by using the Hb level of 7 g/dl should be avoided in patients with acute myocardial infarcts and unstable angina in patients. Interestingly, residents transfuse on a higher threshold (7.7 g/dl) than staff physicians (6.9 g/dl), although the difference is small. Also, residents order RBC transfusion more often after the nurse drew attention to the transfusion need when compared to staff physicians. Education of ICU physicians may therefore contribute to reducing RBC transfusion rates.

Despite a recent study, showing that second transfusions are unnecessary to reach a Hb level of 7 g/dl, in our study still almost half of the transfusion orders consisted of more than one unit. The majority of patients were given multiple units in the absence of suspicion of bleeding. This may indicate that old beliefs that “a single RBC transfusion is a wasted transfusion” are still current.

The need of transfusion products was overestimated in this study, resulting in units that were not administered to patients. Although some of these wasted orders can be re-issued by the bloodbank for other patients, increased storage time and suboptimal temperature during transport may decrease the quality of the blood product and may increase the risk on acute lung injury. Furthermore, the amount of wasted orders increases the costs of transfusion products, because of
the logistic implications as well as the need for more donors. A possible explanation for the high frequency of non-administered orders may be the suspicion of bleeding. Prospective studies are needed to identify the appropriate amount of transfusion products needed in patients suspected of bleeding with and without coagulopathy.

This study has several limitations. Firstly, we found that Hb-level was moderately restrictive, which is likely to result, at least in part, from landmark trials such as performed by Hebert et al. However, we did not investigate whether pre-transfusion Hb-levels in our ICU were higher before the publication of the landmark trials. Secondly, we did not investigate the outcome of patients. Therefore, we cannot conclude whether pre-transfusion Hb-levels were appropriate. Thirdly, this is a single center study. We cannot exclude that reasons to transfuse may differ between institutions. Furthermore transfusion practice might have changed during the 10-week period because of the questionnaire itself. However, only the first transfusion was taken into account and questionnaires were given after the product was ordered.

In conclusion, this study showed that suspicion of bleeding is a major determinant of transfusion. In non-bleeding patients, physiological parameters are modestly taken into account. Ordering and transfusion of multiple units is common, also in the absence of bleeding. Education of ICU physicians on clinical parameters of tissue hypoxia and on single unit transfusion may reduce transfusion rates.
Reference List


