

Appropriateness of red cell transfusion practices in an intensive care unit: A prospective observational study

INTRODUCTION

The anaemia of critical illness is commonly managed with red blood cell (RBC) transfusions and recent studies have shown that up to 50% of such patients receive RBC transfusions.^[1]

Traditionally, the decision to transfuse RBCs often rested on insensitive markers of oxygen delivery and consumption like the haemoglobin (Hb) level or the haematocrit. But the physiological responses that are normally activated when the Hb concentration drops below a critical limit may be blunted in critical illness.^[2] The hazardous nature of RBC transfusions, involving both infectious and non-infectious complications, is also well known. Therefore, it is evident that multiple factors should be considered when making the decision to transfuse RBCs in critically ill patients.

Even though there are widely accepted guidelines for RBC transfusion, a worldwide survey showed a variation in Hb thresholds for transfusion among sub-populations in the intensive care unit (ICU), deviating from these principles. ICU-specific transfusion guidelines were also found to be lacking in the majority of ICUs in this survey.^[3] As there were such variations in transfusion practices, an audit of the prevailing transfusion practices in our ICU was undertaken, after which, the criteria laid down by the British Committee for Standards in Haematology (BCSH) in 2012 were applied to judge the appropriateness of the transfusion practices.^[4]

METHODS

This prospective study was done in the ICU of a medical college hospital and included all the adult patients over 18 years of age who received packed RBCs or whole blood transfusions during their ICU stay, over a period of one year. The study was approved by the research and ethics committee of the institution and was conducted in accordance with the principles of the declaration of Helsinki. Jehovah's

witnesses (inability to receive transfusions) and patients less than 18 years of age were excluded. Based on a population size of 650 admissions to the ICU per year, a hypothesized frequency of inappropriate transfusions of $20\% \pm 5$, and confidence level 95%, the formula: $n = [DEFF * Np (1 - p)] / [d^2 / Z_{1-\alpha/2}^2 * (N - 1) + p * (1 - p)]$ (n = sample size, DEFF = design effect, Z = critical value, p = expected prevalence, d = margin of error) was used to calculate the sample size. The sample size was found to be 179, and it was rounded off to 200. A transfusion event was considered to have occurred when any packed RBC or whole blood was transfused at any time during the patient's ICU stay. Each transfusion event was considered an independent one and was evaluated independently of earlier transfusions, even if it was in the same patient. In case of more than one indication applied to an event, it was taken to be multifactorial. Data regarding transfusions over the previous day (12 midnight to 12 midnight) was collected daily as per the study protocol, until discharge from, or death, in the ICU. The Statistical Package for the Social Sciences version 21.0 software was used. Descriptive statistics were used and data were represented as means \pm standard deviation. Student's t test was used to analyse the collected data. Finally, the transfusion appropriateness was assessed as per BCSH (2012) guidelines.

RESULTS

The study population comprised 200 adult patients, and a Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) chart was used for the study. Over a period of one year, 332 units of packed RBCs/whole blood were used for transfusion in this group. Amongst these 200 patients, 112 (56.00%) patients were male and 88 (44.00%) patients were female, with a male-to-female ratio of 1.2:1, and mean age of 52.72 ± 18.03 years. More than half of the patients (65.5%) belonged to the medical category, followed by emergency surgical (17.5%) and trauma (11.5%). Further categorisation of the patients showed that the majority were admitted under the various medical specialities (33.5%, 12%, and 10% under general medicine, neurology, and nephrology, respectively). General surgical category included 16% patients. Patients admitted under all the other specialities were less than 10% in each category. A mean acute physiology and chronic health evaluation (APACHE) II score of 23.36 ± 6.89 was recorded in the patients on admission to the ICU.

While 19.5% (39) of the patients had ischaemic heart disease/cardiac failure, only 7.5% (15) had an acute coronary syndrome. Most of the study population (86.5%) did not have any evidence of any acute intracranial pathology, although comorbidities like diabetes mellitus and systemic hypertension were present in 76.5%.

Even though only 7% had active bleeding on admission, 41.5% of the patients had evidence of recent blood loss prior to admission and 26.5% were postoperative patients. Majority of the patients (72.5%) had evidence of tissue hypoxia (lactate >4 millimoles per litre/cool peripheries/delayed capillary refill/peripheral cyanosis or mottling/low central venous oxygen saturation) on admission, with 69% of these requiring circulatory support. Our study population had a high requirement for mechanical ventilation (82.4%), although renal replacement therapy was needed only in 36.5%.

Out of the 332 transfusion events, 99.4% of transfusions were done with packed red cells and whole blood was used only in 0.6%. The Hb level on ICU admission and pre-transfusion are given in Table 1. The post-transfusion change in Hb level was also noted with the Hb level increasing by 1 to 5 gm% in the majority (66.9%), less than 1 gm% increase in 31.6% of patients, and more than 5 gm% in the remaining 1.5% of patients.

The mean Hb on ICU admission was 8.98 ± 2.24 g/dL and pre-transfusion Hb was 7.72 ± 1.19 g/dL. Most of the patients (78.5%) were transfused within the first week of ICU admission and in the remaining 21.5%, transfusions took place after the first week with the mean transfusion requirement per patient being 1.57 ± 0.81 units.

Transfusion related complications were minimal, with an allergic reaction in 0.3% and transfusion-associated circulatory overload (TACO) in 3.6%, while there was a mortality of 22.5% (45 patients) in the study population.

A total of 332 transfusions were carried out in 200 patients, and 36 of these (10.8%) were deemed inappropriate [Table 2]. Amongst these 36 transfusions, 29 were carried out at a Hb level between 7 and 10 g/dL despite the absence of tissue hypoxia/acute coronary syndrome/traumatic brain injury or septic shock, and in the remaining seven cases, at a Hb level of >10 g/dL.

Hb level (g/dL)	Hb on ICU admission Percentage (%)	Pre-transfusion Hb Percentage (%)
Less than 7	15.5	22.9
7-10	57.5	75
More than 10	27	2.1
Total	100	100

ICU: Intensive care unit; Hb: Haemoglobin

Appropriateness	Percentage (n)
Appropriate	89.2 (296)
Inappropriate	10.8 (36)
Total	100 (332)

n=number

DISCUSSION

This study was carried out to examine the appropriateness of RBC transfusion in critically ill patients admitted to the ICU. The patients had a mean APACHE II score of 23.36 ± 6.89 on admission with 72.5% having evidence of tissue hypoxia. They also had a high requirement for supportive therapies like circulatory support (69.0%), mechanical ventilation (82.5%), and renal replacement therapy (36.5%).

On admission, a mean Hb level of 8.98 ± 2.24 g/dL was recorded amongst the patients. A geographical variation in baseline Hb level on admission has been demonstrated in an audit by Vincent *et al.*,^[5] where the percentage of patients with Hb <7 g/dL (on ICU admission) ranged from 12% in Africa to 3.5% in Western Europe. The lower Hb value on admission in our study population could be related to this difference. The mean Hb value in our patients dropped from 8.98 ± 2.24 g/dL on ICU admission to 7.72 ± 1.19 g/dL prior to transfusion, as expected in critically ill patients.^[6] Since more than half (57.5%) of our patients were anaemic on ICU admission (as defined by the Hb level), with the majority in shock, and with evidence of tissue hypoxia, the use of blood as part of the ongoing resuscitation process and the need to correct the pre-existing anaemia in many of these patients possibly led to 78.5% of the study population being transfused within the first week. Most of our patients (96.1%) did not have any complications due to the red cell transfusions, although 3.6% of the patients developed TACO. Among the 200 transfused patients in our study, 22.5% expired. A worldwide audit also found a comparable mortality rate of 21.5% in critically ill patients who received blood transfusions.^[5]

A total of 36 transfusions (10.8%) were found to be inappropriate in the current study [Table 2]. A two-year Canadian study showed that more than half of red cell transfusions in the ICU do not comply with established guidelines.^[7] A worldwide audit proved that there was considerable variation in transfusion practices among different geographic regions, though studies on ICU transfusion practices from the developing countries were few.^[5]

Studies from as far back as 1999, proved the advantages of restrictive red cell transfusion strategies in managing the anaemia of critical illness (with some exceptions).^[8] In the ensuing two decades, multiple transfusion guidelines were formulated incorporating a restrictive transfusion strategy, with even the most recent clinical practice guidelines supporting this strategy.^[9] Moreover, in developing nations, blood bank practices may not follow the same stringent standards of screening for infectious diseases uniformly, as in western countries. This is evident from a recently published article on transfusion transmitted infections (TTIs), which describes the transfusion of blood contaminated with a rare organism.^[10] Another Indian study pointed out the higher rate of cancer recurrence in surgical oncology patients, who received blood transfusions,^[11] which is thought to be due to transfusion-related immunomodulation (TRIM). Hence, over the years, restrictive transfusion guidelines have been widely accepted all around the world, but strict adherence to the same is still not universally practised.

Even though transfusion guidelines from western nations are widely followed, data on the appropriateness of transfusion based on the BCSH 2012 guidelines are not available from Indian ICUs. On comparing the data with that from western studies, it was found that the rate of inappropriateness was much less in our ICU. This could be because we followed strict evidence-based red cell transfusion practices in our ICU, indicating that it is possible to meet the standards laid down by accepted guidelines even in a developing country like ours.

CONCLUSION

The red cell transfusion practices in our study population were as good as, or even better than most western studies, and adhere to accepted guidelines as in BCSH 2012, which have stood the test of time ever since they were formulated.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Submitted: 30-Nov-2021

Revised: 05-Nov-2022

Accepted: 05-Nov-2022

Published: 18-Nov-2022

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Access this article online	
Quick response code	Website: www.ijaweb.org
	DOI: 10.4103/ija.ija_1027_21

How to cite this article: Mathew SC, Bhatia G, Kaur R, Mathai AS. Appropriateness of red cell transfusion practices in an intensive care unit: A prospective observational study. *Indian J Anaesth* 2022;66:796-9.