Indications for Red Cell Transfusion in the Intensive Care Unit at the University Hospital of the West Indies

K Fletcher[1], I Tennant[1], CA Walters[2], H Harding-Goldson[1]

ABSTRACT

Objective: *To determine current red cell transfusion practices, transfusion indications and their relationship to patient outcome in intensive care unit (ICU) patients at the University Hospital of the West Indies (UHWI).*

Method: *An observational study was conducted over seven months in the two ICUs at the UHWI, on all patients over 16 years who had been admitted for more than 24 hours. Patient demographics, indication(s) for transfusion, haemoglobin level at the time of transfusion, details of ICU admission and patient outcome were recorded. Data analysis was done using Stata v12.*

Results: *Of the 203 patients included in the study, 79 were transfused (39%). A low haemoglobin level was the most common indication for transfusion, with a mean of 7.3 ± 1.5 g/dL. Patients who were transfused had higher phlebotomy volumes [61.9 versus 126.1 mL,* $p < 0.001$*], were more likely to require mechanical ventilation (*$p = 0.002$*) and inotropic support (*$p = 0.007$*). Most were surgical patients (*$p = 0.01$*) and were post-open heart/thoracic surgery (66% transfusion rate). Patient outcome was correlated with transfusion, as transfused patients had longer ICU stays (13.0 versus 6.7 days,* $p < 0.001$*) and increased mortality rates (32.9% compared to 20.2%,* $p = 0.04$*). Most transfusions occurred within the first week of admission (83.5%).*

Conclusion: *The mean haemoglobin for transfusion at the ICU, UHWI, is 7.3 g/dL, just above the recommended trigger of 7.0 g/dL in a restrictive transfusion practice. Transfusion policies are needed to better allocate a scarce commodity and minimize complications associated with blood transfusion.*

Keywords: Anaemia, ICU, transfusion

Indicaciones para la Transfusión de Glóbulos Rojos en la Unidad de Cuidados Intensivos del Hospital Universitario de West Indies

K Fletcher[1], I Tennant[1], CA Walters[2], H Harding-Goldson[1]

RESUMEN

Objetivo: *Determinar las prácticas actuales de la transfusión de glóbulos rojos, las indicaciones para la transfusión, y su relación con los resultados de los pacientes en la unidad de cuidados intensivos (UCI) del Hospital Universitario de West Indies (HUWI).*

Método: *Por más de siete meses en las dos UCI de HUWI, se realizó un estudio observacional de todos los pacientes mayores de 16 años ingresados por más de 24 horas. Se registraron los datos demográficos del paciente, las indicaciones para la transfusión, el nivel de hemoglobina en el momento de la transfusión, los datos de ingreso a la ICU, y los resultados de los pacientes. El análisis de datos se realizó con Stata v12.*

Resultados: *De los 203 pacientes incluidos en el estudio, 79 fueron transfundidos (39%). Un nivel de hemoglobina bajo fue la indicación más común para la transfusión, con una media de 7.3 ± 1,5 g/dL. Los pacientes que fueron transfundidos tenían mayores volúmenes de flebotomía [61.9 frente a 126.1 mL,* $p < 0.001$*], eran más propensos a requerir ventilación mecánica (*$p = 0,002$*) y apoyo inotrópico (*$p = 0.007$*). La mayoría eran pacientes quirúrgicos (*$p = 0.01$*), y se trataba de post cirugías cardíacas/torácicas abiertas (tasa de transfusión 66%). Los resultados de los pacientes fueron correlacionados con las transfu-*

From: [1]Department of Surgery, Radiology, Anaesthesia and Intensive Care and [2]Dean's Office, Faculty of Medical Sciences, The University of the West Indies, Kingston 7, Jamaica.

Correspondence: Dr K Fletcher, PO Box 77, Kingston 7, Jamaica. E-mail: kelly.fletcher02@uwimona.edu.jm; kellycfletch@gmail.com

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siones, ya que los pacientes transfundidos tuvieron largas estancias en la ICU (13.0 frente a 6.7 días, p *< 0.001) y mayores tasas de mortalidad (32.9% en comparación con 20.2%,* p *= 0.04). La mayoría de las transfusiones se produjeron dentro de la primera semana de ingreso (83.5%).*
Conclusión: *La hemoglobina promedio para la transfusión en la UCI, HUWI, es 7.3 g/dL, justo por encima del umbral transfusional de 7.0 g/dL recomendado en una práctica de transfusión restrictiva. Se necesitan políticas de transfusión que hagan posible una mejor asignación de un recurso tan escaso, y reduzcan a un mínimo las complicaciones asociadas con la transfusión de sangre.*

Palabras claves: Anemia, UCI, transfusión

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INTRODUCTION

In many intensive care units (ICUs), the majority of patients are anaemic at the time of admission [haemoglobin < 13 g/dL in males and 12 g/dL in non-pregnant females] (1). There are numerous reasons for this including blood loss, impaired iron, folate and vitamin B12 metabolism and low circulating erythropoietin. The decision to transfuse must balance the need for adequate oxygen-carrying capacity with the risks of transfusion and limited resources. Numerous studies have been done worldwide that have determined that haemoglobin levels as low as 7 g/dL are well-tolerated in ICU patients (2, 3). There are no published data on actual transfusion practices in ICUs in Jamaica. In addition, there are no transfusion practice protocols at the ICU, University Hospital of the West Indies (UHWI). This study was conducted to determine current transfusion practices and the indications for these transfusions in the ICU, UHWI, and to compare these with international guidelines. The results of this study can be used to make recommendations for better allocation of blood products as well as implementation of transfusion policies.

SUBJECTS AND METHODS

This study was conducted at the UHWI, which is a type A referral and teaching hospital situated in Kingston, Jamaica, affiliated with the University of the West Indies. The total bed capacity is 579, with two eight-bed general ICUs. This study was a retrospective observational study and included all adult patients > 16 years with an ICU stay greater than 24 hours, admitted between January 1, 2013 and July 31, 2013, inclusive.

Data collected included patient demographics, transfusion details including indication(s) for transfusion and haemoglobin level at time of transfusion, admitting diagnosis and medical service, information on ICU course including phlebotomy volumes and patient outcome. Data were extracted from patient and laboratory records. All red cell transfusions occurring over a 24-hour period were considered as a single "transfusion event" (more than one indication could apply to the same event). All transfusion events and indication/s occurring during the ICU admission period were recorded.

The transfusion indications were adapted from the National Institutes of Health Consensus Conference transfusion criteria [USA] (4). Indications included active bleeding, assistance with weaning from ventilatory support, myocardial ischaemia and a low haematocrit (as determined by the attending physician). There was also an option for physicians to enter an indication that did not fit into any of the categories provided.

The data were analysed using Stata v.12. Univariate, bivariate and multivariate relationships between transfusion and variables such as acute physiology and chronic health evaluation (APACHE) II score, age, phlebotomy volumes, length of stay in the ICU and outcome. The relationships between variables were examined using the Student's *t* test and Chi-squared test as well as the Wilcoxon rank sum test (Mann-Whitney U) in situations where the data were skewed. A *p*-value of less than 0.05 was accepted as statistically significant. Logistics regression models were generated to assess independent factors related to outcome.

RESULTS

Of the 210 patients who met the inclusion criteria (out of a total of 310 admissions), complete data were obtained for 203 (96.6%). Approximately half of those studied were male (51%, 103 patients). Mean age (± standard deviation) at admission was 51.3 ± 19.3 years with no significant difference based on gender [male 51.3 ± 17.4 years *versus* female 51.5 ± 21.1 years, $p = 0.86$] (Table). The mean ± SD APACHE score was 18.9 ± 8.4; 19.7 ± 8.6 in males *versus* 18.1 ± 8.2 in females [$p = 0.86$].

The majority of patients in the study (68.5%) were admitted by a surgical specialty. Internal medicine accounted for 26.1% of all admissions and the remainder (n = 11; 5.4%) were admitted by obstetrics and gynaecology. Patients were also classified according to diagnosis. Diagnoses used included elective neurosurgery, multi-organ dysfunction syndrome, open heart/thoracic surgery and respiratory failure. Patients who had undergone elective neurosurgery accounted for the largest number of admissions (n = 39; 18.8%) followed by respiratory failure (n = 35; 16.7%). The mean admitting haemoglobin was 10.3 g/dL.

The transfusion rate was 39% (n = 79) and a total of 212 units of red cells were transfused over the study period. The mean haemoglobin prior to transfusion was 7.3 ± 1.5 g/dL. Most of the patients who were transfused received packed red blood cells only once during their admission to ICU (64.6%).

Table: Patient demographics

Characteristic	Total	Gender		*p*-value
		Males	Females	
Number of patients	203	103 (50.7%)	100 (49.3%)	---
Age (year)				
Mean (SD)	51.3 (19.3)	51.3 (17.4)	51.5 (21.1)	0.86
Range	16–89	16–84	16–89	
Admitting service				
Medicine	53 (26.1%)	34 (33.0%)	19 (19.0%)	0.07[a]
Surgery	139 (68.5%)	69 (67.0%)	70 (70.0%)	
OB/GYN	11 (5.4%)	0 (—)	11 (11.0%)	
Length of stay (days)				
Median (IQR)[b]	5 (3–10)	5 (3–10)	5 (3–10)	0.30
Range	1–144	2–144	1–81	
Outcome				
Discharged	152 (74.9%)	82 (79.61%)	53 (67.1%)	0.04
Death	51 (25.1%)	25 (20.16%)	26 (32.9%)	

(a) *p*-value for Chi-squared test of association (excluding persons from obstetrics and gynaecology [OB/GYN])
(b) IQR–interquartile range

Most transfusions occurred within the first week of admission (83.5%). The most common indication for transfusion was a low haemoglobin level (88.6%), which was physician determined, and when averaged in this group, it was 7.2 g/dL. The least common reason was to aid in the treatment of myocardial ischaemia (5.9%). The admitting haemoglobin in the transfused group was 8.9 ± 2.8 g/dL compared to 11.3 ± 2.5 g/dL in the group that was not transfused ($p < 0.001$).

The surgical patients had a higher transfusion rate (44%) when compared with those of the internal medicine group (24.5%), $p = 0.01$. Patients with an admitting diagnosis of open heart/thoracic surgery had the highest transfusion rate at 65.5%. Those with multi-organ dysfunction syndrome and major vascular surgery closely followed with 60% each. In patients with a diagnosis of respiratory failure, only 16.7% were transfused, and just 14.7% of elective neurosurgical patients were transfused (Fig. 1).

Ventilated patients had a higher rate of transfusion, and among the group of patients who were transfused, 44.4% were mechanically ventilated compared to 18.6% in the group not transfused ($p = 0.002$). The transfusion rate in patients requiring inotropes was 58.2% compared to 41.8% in those without inotropic support ($p = 0.007$). In the group of patients requiring inotropes who were transfused, the mean ± SD duration of inotropic support was 5 ± 5.2 days. In the group requiring inotropes who were not transfused, the mean duration of inotropic support was 3 ± 3.1 days ($p = 0.003$).

Patients who received transfusions during ICU admission had larger phlebotomy volumes, with the mean for the transfused patients being 126 mL compared to 62 mL in patients who were not transfused [p < 0.001] (Fig. 2).

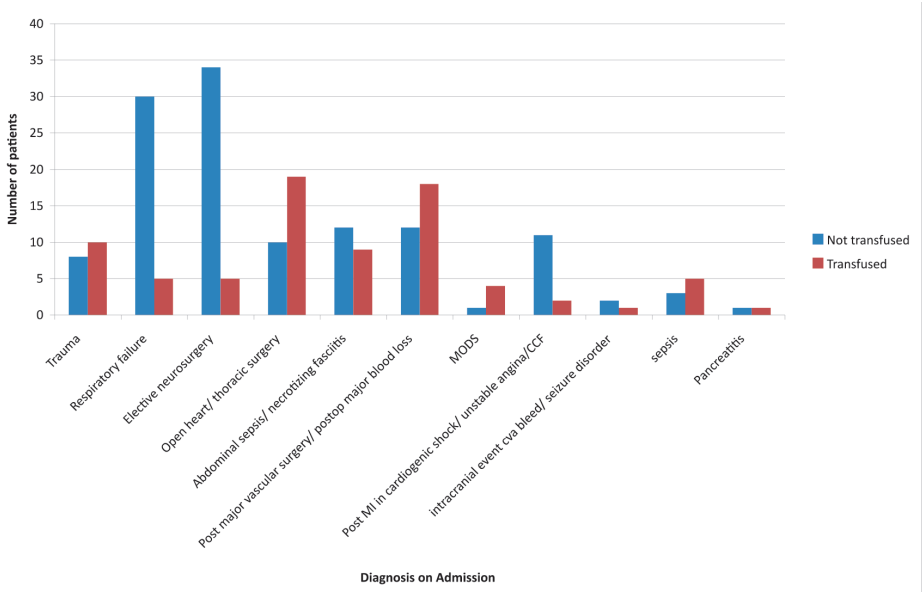

Fig. 1: Transfusion by admitting diagnosis.

MODS: multi-organ dysfunction syndrome; MI: myocardial ischaemia; CCF: congestive cardiac failure; CVA: cerebrovascular accident

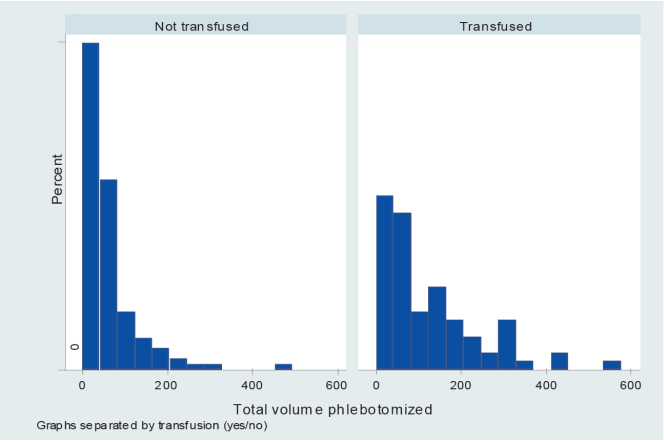

Fig. 2: The relationship between phlebotomy volume and transfusion.

The median length of ICU stay in the transfused group was seven days, with an interquartile range of 3–10 days, compared with 4.5 days in the group not transfused ($p < 0.001$), based on the Wilcoxon rank-sum test. The overall mortality rate of the study population was 25.1%. The mortality rate of the patients who were transfused was 32.9% compared to 20.2% in the patients who were not transfused ($p = 0.041$). Logistics regression analysis showed that when the APACHE II score, admitting haemoglobin, volume phlebotomized and the ICU length of stay were taken into account, there was no significant relationship between transfusion and outcome.

DISCUSSION

Based on the findings of this study, the transfusion threshold used by clinicians in the ICU at the UHWI is slightly higher than that described as restrictive (7 g/dL) in the Transfusion Requirements in Critical Care trial in 1999 (5). In this study, patients were divided into two groups, a liberal transfusion group where patients were maintained at a higher haemoglobin (10 g/dL) and a restrictive group. The investigators found that the restrictive strategy was at least as effective if not superior to the liberal strategy. Although by classical definition, we are not restrictive in our practices (trigger of 7.3 g/dL), other studies done at institutions around the world reported transfusion triggers that were much higher. The CRIT study (2004) of 284 ICUs in the United States of America quoted a mean ± SD haemoglobin level at the time of transfusion of 8.6 ± 1.7 g/dL (6). This difference is probably due to the limited availability of blood products in Jamaica when compared to the USA. However, a study done by Toppin in 2007 investigated ICU physicians' self-reported blood transfusion practices in the English-speaking Caribbean (7). His questionnaire provided examples of clinical scenarios and physicians were asked if they would transfuse such patients. With a 91% response rate, the study showed that 85% of participants used current literature to determine when to transfuse in the given scenarios and were more likely to transfuse the elderly and those with high APACHE II scores. His study demonstrated that in a theoretical situation, physicians tended toward restrictive practices (7). This study suggests that our physicians tend toward restrictive practice in theory; however, this was not fully demonstrated in actual practice, as shown in our survey.

When compared with our Caribbean neighbours in Trinidad and Tobago by Bedayse *et al*, who conducted a similar study in 2010, the transfusion rate in the ICUs at the UHWI was higher [38.9% compared with 29.8%] (8). The Trinidad and Tobago study population differed in that the majority of their patients were admitted for "respiratory illnesses" *versus* elective neurosurgery in our population. The study of anaemia and blood transfusion in critically ill patients conducted in Europe also demonstrated a lower transfusion rate of 37% despite the ready availability of blood products (2). The Trinidad and Tobago study demonstrated a restrictive transfusion strategy with a mean "trigger haemoglobin" of 6.73 g/dL (8).

Deleterious associations seen with transfusions documented in international studies were also experienced in our setting. These included longer length of stay in ICU, increased duration of ventilatory support and higher mortality rates (9). Median length of stay in the CRIT study was done by the number of units transfused, thus the median length of stay for those receiving 1–2 units of blood was 3.5 days longer than those who received no blood transfusions, and for each additional unit transfused, the number of days spent in both ICU and hospital increased (6). This study found an increase in length of stay of approximately 2.5 days once the patient was transfused. However, it is unclear whether transfusion resulted in complications that increased ICU stay, or if the longer ICU stay increased the likelihood that these patients would need transfusion. A longer ICU stay may be associated with increased phlebotomy volumes, sepsis and ventilator days, all of which are also associated with the need for transfusion. Interestingly, higher APACHE II scores were not associated with an increased transfusion rate, unlike other studies (10).

Mortality was also associated with transfusion when bivariate analysis was used; more patients who were transfused died compared with those who were not. This is in keeping with previous studies of critically ill patients such as the TRICC trial (5). The overall 30-day mortality in the TRICC trial was not significantly different between the two groups: restrictive *versus* non-restrictive. However, in smaller subgroups – those who were less acutely ill and those < 55 years of age – a restrictive strategy was associated with a better outcome (5). Marik and Corwin did a systematic review of the literature in 2008 and continued to demonstrate increased morbidity and mortality associated with transfusion in critically ill patients (11).

CONCLUSION

The mean haemoglobin of 7.3 g/dL triggering transfusion by physicians of the ICU at the UHWI is slightly above the recommended restrictive practice of not transfusing unless the haemoglobin level falls below 7 g/dL. It must be noted, however, that our "trigger haemoglobin" is lower than other stud-

ies where the haemoglobin trigger levels have been reported as high as 9 g/dL (12). Deleterious associations seen with transfusions in studies across the world were also noted in our setting. These included longer duration of stay in ICU, the need for inotropic and ventilatory support as well as death. In light of this fact and our lack of resources both in terms of reagents for the myriad of blood investigations done in the ICU and the limited blood donor pool, a transfusion protocol which reinforces a restrictive policy should be employed, as is standard in other institutions, to better allocate these precious commodities, and also prevent associated deleterious effects of blood transfusion (13). This protocol should be aimed at educating all medical personnel about the benefits and cons of blood transfusion. It should be evidence based, highlighting negative associations with blood transfusion, especially in critically ill patients. It must be emphasized that the decision to transfuse should not be based solely on the haemoglobin of the patient but also on the clinical status of the patient (14). The management of complications of transfusions such as transfusion-associated lung injury (TRALI) must also be included (15). Although other blood component infusions were not the subject of this study, any protocol which guides the use of red cell transfusions must also include guidelines for the use of other blood components.

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