Original articles

Blood Transfusion Practice Indicated by Paediatric Intensive Care Specialists in Response to Four Clinical Scenarios

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ABSTRACT

Objective: *Several clinical guidelines exist for blood transfusion in adults but only one refers to children. There are no guidelines for blood transfusion in critically ill children and the paediatric intensive care specialist's approach is unknown. We wished to evaluate the approach toward blood transfusion among a group of paediatric intensive care specialists.*

Methods: *All certified paediatric intensive care specialists from the Israeli society of pediatric intensive care medicine were requested to complete a questionnaire, which described four hypothetical common scenarios in paediatric intensive care units. In each case, the physicians were asked to denote the haemoglobin threshold at which they would prescribe a blood transfusion and the transfusion volume they would use. The specialists were also asked for their reasons for increasing their haemoglobin threshold for blood transfusion.*

Results: *The questionnaire was posted to twenty six paediatric intensive care specialists, twenty one of whom responded (i.e. 80.8%). There was a wide variation for each scenario in both the suggested haemoglobin thresholds for transfusion (varying by 20 - 50 g/L) and the transfusion volume (varying by 10 - 20 mL/kg). The reasons given for increasing their blood transfusion threshold included, in order of importance, shock, haemodynamic instability and hypoxaemia.*

Conclusions: *There is a marked variability among paediatric intensive care specialists regarding both the threshold haemoglobin level at which blood transfusion is prescribed as well as the volume used.* (**Critical Care and Resuscitation 2002; 4: 261-265**)

Key words: blood, transfusion, haemoglobin, paediatric intensive care unit

To avoid complications associated with transfused blood,[1,2] clinicians tend to restrict the use of blood transfusions as much as possible by lowering the haemoglobin threshold for a transfusion. Guidelines concerning blood transfusions in adult populations have been published by the American society of anesthesiologists,[3] the Canadian medical association,[4] and the American College of Physicians[5] on the basis of meta-analyses of randomized control studies. Nevertheless, a study performed by Hebert *et al*,[6] among Canadian adult intensive care physicians, revealed that more than 40% still adhered to a "threshold trigger" of 100 g/L.

Currently, there are no detailed guidelines for blood transfusion in the paediatric patient.[7,8] The recommendations of the American association of blood banks,[9] regarding blood transfusion in children, are relatively general and do not address the critically ill child. Furthermore, the approach of paediatric intensive care

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specialists in considering transfusion in an anaemic paediatric patient has not been studied. We conducted a survey among a group of Israeli paediatric intensive care specialists to evaluate their approach toward blood transfusion in critically ill children.

MATERIALS and METHODS

A questionnaire was sent to all certified Israeli paediatric intensive care specialists (a list was provided by the Israeli society of pediatric intensive care medicine). Two weeks later, a second mailing to the paediatric intensive care specialists who had not responded and an electronic form of the questionnaire (to facilitate return by electronic mail) was conducted.

The questionnaire was divided into three parts. Part one contained data on physician characteristics, namely specialty and number of practicing years in a paediatric intensive care unit (PICU), academic degree and PICU characteristics (i.e. number of beds and university affiliation - yes/no). Part two of the questionnaire contained a description of four hypothetical clinical scenarios. Each focused on a clinical case commonly encountered in the PICU (table 1). In each case the paediatric intensive care specialists were asked to select the haemo-globin level at which they would administer a blood transfusion and the volume they would use. In the third part of the questionnaire, the physicians were asked to list, in order of importance, their considerations for a blood transfusion at a higher haemoglobin level. The questionnaires were completed anonymously.

Chi-square test was used to analyze differences between proportions for categorical variables. Probability levels (p) less than 0.05 were considered statistically significant. Analyses were done with the SPSS for Windows Software (SPSS, Inc., Chicago, IL).

RESULTS

Of the 26 certified paediatric intensive care specialists regularly employed in PICUs, 21 (80.8%) completed the questionnaire. The characteristics of the respondents and the PICUs in which they work are detailed in Table 2.

In the first scenario the haemoglobin thresholds for blood transfusion ranged from 70 to 90 g/L, with a mean (± SD) value of 73 ± 5.7 g/L. In the second scena-rio the haemoglobin thresholds for blood transfusion ranged from 70 to 120 g/L, with a mean (± SD) value of 97 ± 13 g/L. In the third scenario the haemoglobin thresholds for blood transfusion ranged from 70 to 100 g/L, with a mean (± SD) value of 87 ± 8.5 g/L, and in the fourth scenario ranged from 70 to 120 g/L, with a mean (± SD) value of 96 ± 12.4 g/L. The haemoglobin thresholds for blood transfusion among paediatric intensive care specialists are also shown in figure 1.

Table 1. Clinical scenarios used in the questionnaire

Scenario 1

A six-year-old child admitted to the paediatric intensive care unit (PICU) after fixation of a femoral fracture. He is well oxygenated on room air and stable haemodynamically.

Scenario 2

A two-year-old child with acute respiratory distress syndrome due to aspiration. He is mechanically ventilated with a peak inspiratory pressure (PIP) of 28 cmH_2O, positive end expiratory pressure (PEEP) 12 cmH_2O, inspired oxygen concentration (F_IO_2) 80% and respiratory rate (RR) 28 breaths per minute. An arterial blood gas analysis reveals a PO_2 59 mmHg, PCO_2 43 mmHg and pH 7.39. He is stable haemodynamically.

Scenario 3

A ten-month-old infant, 3 hours after a complete operative correction of an atrioventricular septal defect (AVSD). He is normovolemic and not bleeding. He receives dopamine at 7.5 μg/kg/min. His heart rate and blood pressure are within the normal range for his age. Ventilation parameters are: PIP 24 cmH_2O, PEEP 4 cmH_2O, FiO_2 60%, RR 24 breaths per minute and he maintains normal blood gas levels.

Scenario 4

A four-year-old child with Gram-negative septic shock treated with boluses of fluid, dopamine 10 μg/kg/min, dobutamine at 7.5 μg/kg/min and antibiotics. With this treatment, blood pressure is 70/40 mmHg, capillary filling time is 5 seconds and urine output is 0.4 mL/kg/hour. Ventilation parameters are as follows: PIP 26 cmH_2O, PEEP 4 cmH_2O, FiO_2 35%, RR 20 breaths per minute. An arterial blood gas analysis reveals a PO_2 95 mmHg, PCO_2 42 mmHg and pH 7.30.

Table 2. Characteristics of the paediatric intensive care specialists who completed the questionnaire

Characteristics	*Number of specialists*
Academic rank	
None	11
Lecturer	7
Assistant professor	3
University affiliation	
Yes	18
None	3
Years of PICU practice	
> 15	5
10 - 15	8
5 - 10	7
< 5	1
Number of PICU beds	
≤ 3	3
4 - 6	8
7 - 12	9
≥ 13	1

PICU = Paediatric intensive care unit

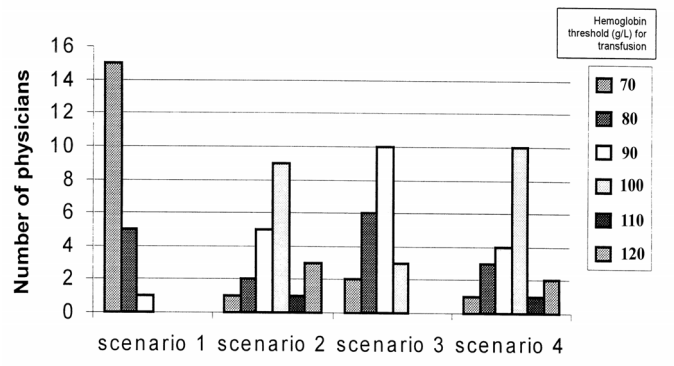

Figure 1. The haemoglobin thresholds indicated in each of the four clinical scenarios by the paediatric intensive care specialists.

The transfusion volume suggested by the paediatric intensive care specialists ranged, for all scenarios, from 10 to 20 mL/kg with mean (± SD) values of 14.2 ± 3.6 mL, 13.5 ± 3.9 mL, 13.0 ± 3.3 mL and 14.8 ± 3.5 mL for case scenarios 1, 2, 3 and 4 respectively (figure 2). Eleven responders (52.4%) did not change the transfused volume regardless of the clinical scenario. No statistically significant correlations were found between clinician background data and the thresholds or volumes of blood transfusion beside tendency ($p < 0.05$) of university-affiliated physicians to transfuse large volumes (20 mL/kg) to patients in scenarios 1 and 4.

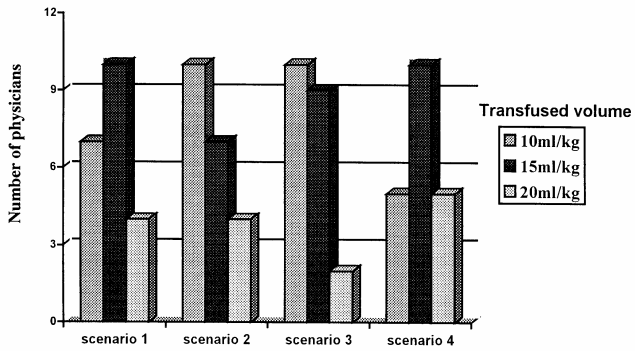

Figure 2. The transfused volume indicated in each of the four clinical scenarios by the paediatric intensive care specialists.

The reasons given for considering a more liberal approach (i.e. an elevated threshold) toward blood transfusion were: shock and haemodynamic instability by 11 (52.4 %) responders, hypoxaemia by 8 (38.1%) responders, need to improve oxygen delivery by five (23.8%) responders and mechanical ventilation by 4 (19%) responders. A detailed list is given in table 3.

Table 3. Main considerations listed for elevating the threshold for blood transfusion

Considerations	*Number of specialists*
Shock and haemodynamic instability	11
Hypoxaemia	8
Need to improve oxygen delivery	5
Cyanotic heart disease	4
Mechanical ventilation	4
Respiratory distress	3
Bleeding	3
Neonatal patient	2
Metabolic acidisis	2
Sepsis	2

DISCUSSION

The majority of literature studying the effect of transfusion haemoglobin threshold on patient morbidity and mortality has been on adult patients. In paediatric literature, it is not clear what the appropriate haemoglobin threshold for transfusion is and whether it changes with different clinical situations. Lucking *et al*,[10] found that, in septic children, a haemoglobin level of 93 g/L was insufficient to overcome tissue oxygen demands and that increasing oxygen delivery, by blood trans-fusion, increased oxygen consumption. Similar studies performed by Mink *et al*,[11] on septic children, and by Seear *et al*,[12] in post cardiac surgery children, failed to demonstrate the same results.

However, a much lower haemoglobin threshold for blood transfusion has been reported to increase mortality. Lackritz *et al*,[13] reported anaemic children with haemoglobin less than 39 g/L and who were not transfused had an increased mortality compared with a similar group with haemoglobin less than 39 g/L who were transfused. Similar results were reported by Holzer *et al*.[14]

The American association of blood banks recommendations are more liberal regarding the haemoglobin threshold for transfusion, namely, a haemoglobin of 80 g/L or less in cases of chronic symptomatic anaemia or anaemia due to chemotherapy and a haemoglobin of 130 g/L or less in cases of severe cardiopulmonary disease.[9] These studies and recommendations highlight the wide range of tissue oxygen demands in different subgroups of critically ill children and the lack of standardized criteria to guide paediatric intensive care specialists regarding blood transfusion.

These recommendations may explain the results of our study which demonstrated a wide range of haemoglobin thresholds for blood transfusion used by the paediatric intensive specialists, for the same clinical scenario in critically ill children. While some paediatric intensive care specialists accepted a haemoglobin of 71 g/L as satisfactory for their patient's oxygen demands, others believed that 119 g/L was too low and indicated that they would administer a blood transfusion. On the one hand a too-restrictive policy, may place some patients at risk of tissue hypoxia, whereas on the other hand, because of a too-liberal transfusion policy, some patients may be unnecessarily exposed to the risks of blood transfusion.

The variability regarding blood transfusion extended also to the volume of blood being transfused. Some physicians indicated that they would use 10 mL/kg of blood, whereas others indicated that they would use 20 mL/kg. This variability is also reflected in the literature, with different authors recommending different volumes with a range of 10 - 15 mL/kg.[15,16] Thus in order to transfuse to a certain haemoglobin level, some physicians may expose the patient twice to a blood transfusion and therefore expose the patient to 2 donors (particularly when using a low volume approach).

While this report did not cover all, or even most, clinical situations involving the need for blood transfusion, it highlighted the differences in current transfusion practice and the uncertainty surrounding the indications for blood transfusion in critically ill children.

We conclude that there appears to be a marked variability among paediatric intensive care specialists regarding the threshold haemoglobin level below which a transfusion of red blood cells is needed and the volume required. These data indicate the need for further research to develop valid guidelines to assist the paediatric intensive care specialist regarding the appropriate threshold haemoglobin and volume required when transfusing blood in critically ill children.

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