

Is there a difference between small and large volume red blood cell transfusion in critically ill children allocated to a lower versus a higher hemoglobin threshold (70 vs 95 g/L)?



Centre de Recherche du
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Le centre hospitalier
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Pour l'amour des enfants

Université
de Montréal

AUTHORS

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INTRODUCTION

The volume of Red Blood Cells (pRBC) administered in critically ill children is variable, ranging from 5 to > 30 mL/kg per transfusion (ABC-PICU randomized controlled trial^{1,2}).

Available guidelines are inconsistent; some of them recommend volumes up to 15 - 20 mL/kg/transfusion in children.³

In adults, transfusing 1 pRBC unit per transfusion is standard practice, unless there is life-threatening hemorrhage. Given that a typical pRBC unit in Canada is about 300 mL, a 70 kg adult would receive about 5 mL/kg per transfusion; a volume much lower than recommended and given to most critically ill children.

OBJECTIVES

In order to consider recommending a smaller volume of transfusion, and testing this in a future trial, we sought to determine if the **restrictive arm (70 g/L)** of TRIPICTU received a larger volume of pRBC per transfusion event compared to the **liberal arm (95 g/L)**.

This would allow us to determine if a smaller volume was non-inferior, within the restrictive and liberal arms of TRIPICTU.

METHOD

Design: This is a subgroup analysis of the TRIPICTU RCT⁴

Population: Critically ill children < 14 years, in first 7 days of PICU stay

Intervention: The randomized Hb thresholds were ≤ 70 or ≤ 95 g/L in the **restrictive** and **liberal** arm, respectively.

Outcomes: New or progressive multi-organ dysfunction syndrome (MODS) or 28-day mortality.

Subgroup: Total volume of pRBC received, and volume per transfusion received between restrictive and liberal groups were evaluated, based on targeted post-transfusion Hb. The transfusion goal was to increase the Hb by 15 to 25 g/L in both study arms. The volume/kg of pRBC unit per transfusion was fixed using the following formula:

$$\text{Volume/kg of pRBC unit (mL/kg)} = \frac{\{(Hb_{\text{targeted}} - Hb_{\text{observed}}) \times \text{blood volume}\}}{\{(Hb \text{ in RBC unit})\}}$$

RESULTS

TRIPICTU trial enrolled 637 patients, with no difference at baseline between participants in **restrictive** or **liberal** RBC transfusion arms.

We aimed to increase the Hb by 15 to 25 g/L in both arms (**70 → 85 or 95** in the **restrictive** and from **95 → 110 or 120** g/L in the **liberal** group), resulting in the following volumes:

$$\uparrow \text{Hb by 15 g/L: } \{(85 \text{ or } 110 \text{ g/L}) \times 70 \text{ mL/kg}\} / \{195 \text{ g/L}\} = 5 \text{ mL/kg/transfusion}$$

$$\uparrow \text{Hb by 25 g/L: } \{(95 \text{ or } 120 \text{ g/L}) \times 70 \text{ mL/kg}\} / \{195 \text{ g/L}\} = 9 \text{ mL/kg/transfusion}$$

Patients in the **restrictive** arm who were transfused received a larger volume of RBC units ($\Delta = 3.6$ mL/kg/patient, $p < 0.04$) than those in the **liberal** arm, but the volume/kg per transfusion was similar (11.4 mL/kg).

OUTCOMES

Cases of new or progressive MODS (**38 in restrictive** and **37 in liberal arm**) ARR 0.4% (95% CI -4.6 to 5.5)) and 28-day all-cause mortality (**14 vs 14**, ARR 0 (-3.2 to 3.2)) were similar.

Table 1. Intervention (RBC transfusions according to Hb threshold) in TRIPICTU trial

Red blood cell transfusion strategy	Restrictive	Liberal	P-value
Number of allocated patients in TRIPICTU	320	317	-
A) Patients with ≥ 1 RBC transfusions, n (%)	146 (46)	310 (98)	<0.001
B) RBC units/transfused patient, mean \pm SD	1.9 \pm 3.4	1.7 \pm 2.1	0.24
C) Total volume/kg of RBC unit in PICU stay, mL/kg per transfused patient, mean \pm SD	23.6 \pm 52.5	20.0 \pm 19.3	<0.04
D) Total volume/kg in PICU stay of RBC unit for all transfused patients (C x A), mL/kg	3445	6200	-
E) Total number of transfusions, n	301	542	<0.001
F) Average volume given to TRIPICTU participants (D \div E), mL/kg per transfusion	11.4	11.4	-
G) Targeted volume, mL/kg per transfusion	5 to 9	5 to 9	-

MODS: multi-organ dysfunction syndrome; PICU: pediatric intensive care unit; RBC: red blood cell.

CONCLUSION

- In the TRIPICTU trial, transfused patients in the restrictive arm did not receive larger volumes of transfusion, than those in the liberal arm.
- Therefore, targeting a smaller volume/kg (5 to 9 mL/kg) per RBC transfusion in patients allocated to a restrictive RBC transfusion strategy was non-inferior when compared to a liberal strategy.
- A smaller volume/kg can be safely used in most anemic PICU patients (excluding cyanotic cardiac patients) and that targeting a smaller rather than larger volume (i.e. ≤ 9 vs. ≥ 16) mL/kg per transfusion gives similar outcomes.
- These volumes remain larger than currently recommended adult volumes (about 5 mL/kg).
- Additional studies are needed to confirm whether these observations apply to patients not included in TRIPICTU.

ACKNOWLEDGEMENTS

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