A Sweet Solution for Infant Transfusions?

What is this research about?
Premature infants often require red blood cell (RBC) transfusions to manage anemia of prematurity. However, there is some evidence that RBC transfusions may be associated with necrotizing enterocolitis, a devastating and potentially deadly disease affecting the intestines. Feeds are often stopped before, during and after transfusion to try to reduce the chance of this disease occurring. Unfortunately, this practice comes with other risks. Most importantly, stopping feeds around the time of a transfusion places the infant in danger of developing low blood sugar levels. To avoid this high-risk situation, the infant may also need intravenous infusions of dextrose (sugar) solution. Ideally, the dextrose solution could be infused together with the RBCs. Otherwise a second intravenous access point must be found — something that can be challenging in these tiny infants. Unfortunately, there are concerns that mixing dextrose-containing solutions and RBCs may damage RBCs. Therefore, infusing RBCs and dextrose through the same intravenous site is not advised by clinical guidelines.

Some laboratory-based studies have shown that dextrose may not be harmful to RBCs. However, these studies have had limitations and so their findings have not been widely accepted or put into practice. Here, the researchers designed and conducted a comprehensive laboratory-based study examining the effect of mixing dextrose solutions and RBCs. They aimed to find out whether these solutions could be infused into an infant through the same intravenous access site.

What did the researchers do?
Conducted in a Canadian Blood Services research laboratory, the study was designed to reflect real-life situations that would be found in a neonatal intensive care unit (NICU). RBC units were prepared using standard Canadian Blood Services procedures and stored in the refrigerator in a storage solution. Before the experiments began, the RBC units were irradiated — a common practice to prevent a rare complication of transfusion where the donor white blood cells attack recipient organs and tissues. RBC units stored for five, 14 or 21 days were examined, times that reflect the average age of RBCs transfused to infants in Canadian NICUs. The study was conducted in two phases:

- **Phase 1:** Using the same transfusion equipment used in a NICU, researchers “co-infused” RBCs and several different dextrose-containing solutions into the transfusion equipment at the same time. The volumes of the RBCs and dextrose solutions and the rate of infusion were based on those used in the NICU. The RBCs were then collected and examined for signs of damage.
- **Phase 2:** Researchers mixed RBCs with the dextrose solutions outside of the transfusion equipment. They tested for signs of damage after five, 30 and 180 minutes. These times reflected how long the solution would be mixed together in the event of a slow infusion rate (five minutes), a temporarily suspended transfusion (30 minutes) and a situation in which the transfusion was suspended for its entire duration (180 minutes). All of these situations may occur during an infant’s transfusion.

In both phases, RBCs alone and RBCs infused with a saline solution were also tested as controls for the experiments.

In brief…
This study suggests infusing red blood cells together with dextrose may not damage red blood cells — a finding with implications for the care of premature infants undergoing transfusion.
What did the researchers find?

- **Phase 1:** The main signs of RBC damage measured were how many RBCs had burst (called hemolysis), and RBC volume, shape and flexibility. For these measures, there were no differences between RBCs co-infused with dextrose solutions and control samples. These results indicate that co-infusing RBCs and dextrose solutions through the transfusion equipment did not damage the RBCs. There were no differences seen between the different dextrose solutions tested.

- **Phase 2:** At 30 and 180 minutes, the volume of RBCs was higher in the RBC samples mixed with dextrose solutions than in the control samples. At 180 minutes, RBCs in the dextrose solutions had higher levels of damage (measured by hemolysis) than the RBCs alone. Compared to the other dextrose solutions tested, levels of RBC damage, particularly hemolysis, were lower when a dextrose solution called D10W was used.

How can you use this research?

The results of phase 1 suggest that the level of damage to RBCs co-infused with saline or with a dextrose-containing solution is acceptable. The results of phase 2, however, indicate that mixing RBCs and dextrose solution for longer periods of time may damage RBCs. One of the strengths of this study was that it used conditions that closely reflect common transfusion practices in NICUs worldwide. However, not all possible conditions, transfusion equipment or infusion rates could be tested. The encouraging findings in phase 1 suggest a trial should be conducted to determine whether co-infusion of RBCs and dextrose solutions is feasible in the NICU. The findings of phase 2 suggest that D10W might be a good choice for maintaining acceptable RBC quality. However, when it comes to developing new guidelines, caution is warranted, pending more information on the effect of mixing RBCs and dextrose solutions for longer times.

About the research team:

- **Dr. Amy Keir** is a clinician and researcher currently enrolled in the neonatal-perinatal medicine fellowship training program in the department of pediatrics at the University of Toronto. **Adele Hansen** is a project lead with Canadian Blood Services’ Centre for Innovation and is based at Dr. Jason Acker’s laboratory at the University of Alberta. **Dr. Jeannie Callum** is an associate scientist at the Sunnybrook Research Institute, the director of transfusion medicine and tissue banks at Sunnybrook Health Sciences Centre and an assistant professor at the department of laboratory medicine and pathobiology at the University of Toronto. **Dr. Robert Jankov** is a senior scientist at the Hospital for Sick Children Research Institute, an associate professor in the department of pediatrics and physiology at the University of Toronto, and a staff physician and clinical scientist at The Hospital for Sick Children in Toronto. **Dr. Jason Acker** is a senior development scientist with Canadian Blood Services’ Centre for Innovation and a professor in the department of laboratory medicine and pathology at the University of Alberta.

This ResearchUnit is derived from the following publication:


Acknowledgements: This research received financial support from Canadian Blood Services, funded by the provincial and territorial Ministries of Health. The research was also supported by the Medical Insurance Group of Australia (MIGA) doctors in training grant, the SickKids Research Training Institute trainee start-up fund, and the University of Toronto, division of neonatology trainee grant program. Canadian Blood Services is grateful to blood donors for making this research possible.

Keywords: Red blood cells, transfusion, dextrose, hemolysis, neonates, feeding

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