

Evaluating infusion pump safety for red blood cell transfusions

What is this research about?

Infusion pumps are mechanical devices commonly used in transfusion medicine. Originally designed to assist in the delivery of fluid resuscitation products like crystalloids, infusion pumps have also come to be used in the transfusion of blood products as they can offer benefits to both patients and health-care teams. These benefits can include greater consistency and calculation of flow rate, increased accuracy of infusion volume, increased flexibility in transfusion speed in outpatient settings, and decreased risk of errors compared to gravity-based infusions. However, the growing use of infusion pumps has raised questions about the risk of mechanical damage to red blood cells (RBC).

Health-care facilities that use these pumps rely on manufacturers and regulators to determine whether specific models are approved for infusing red blood cells. There is a lack of literature available to help guide evaluation of infusion pumps for this use and to understand the effects of different conditions, rates, and pump types on the quality of RBCs. Research providing clear evidence on the effect of infusion pumps on RBCs can be valuable to regulators, manufacturers, and health-care facilities responsible for evaluating pump safety for transfusions.

IN BRIEF: "Our study shows that infusion pumps currently used in Canada for transfusion of RBC units are safe and, by performing a comprehensive testing strategy in a variety of settings that are clinically relevant, it provides a framework for the evaluation of infusion pump safety which can be adopted by blood transfusion regulatory bodies."

What did the researchers do?

Using four types of pumps currently approved for use in Canada, researchers investigated the impact of pump type on different measures of RBC quality across four specific RBC unit conditions.

These conditions included irradiated and non-irradiated RBC units as well as units with varying post-collection timelines (e.g., 22 days, 40 days), to represent average ages or shelf-life lengths that would be realistic to Canadian settings. Various rates of transfusion speed were also tested for each pump type and compared to a gravity-based transfusion technique as a control.

Any effect on RBCs due to pumping was examined by *in vitro* measurements of common markers of RBC quality, including % hemolysis (a rupture or breakdown of red blood cells), levels of extracellular potassium, microvesicles and lactate dehydrogenase, as well as morphology and mechanical fragility index.



What did the researchers find?

Of all the measures considered in this study, the level of hemolysis was found to be the most sensitive marker for pump evaluation. Samples pumped at a rate of 50mL/h by the peristaltic pump had the highest hemolysis among all the test combinations. Since hemolysis levels for all pumps were well below both Health Canada, Council of Europe and Association for the Advancement of Blood & Biotherapies (AABB) standards, all pumps tested are considered to be safe for use.

Notably, an important conclusion from this research is that each new pump, regardless of mechanism, needs to be evaluated before use with RBC transfusions due to variability observed between models.

How can you use this research?

By creating a methodology that compares the various infusion pump types available in Canada and identifying important parameters for evaluating their effects on RBCs, this research provides a framework for blood suppliers, manufacturers, and health-care facilities to assess the safety of infusion pumps for use in RBC transfusions.

These research findings can also be informative for hospitals that are considering the use of infusion pumps for transfusion or are preparing to change pump types. For example, this research was followed closely by Vancouver General Hospital (VGH), the biggest user of RBC units in British Columbia. VGH was previously not using infusion pumps for transfusion due to historic uncertainty about the adverse effect of pumps on RBC quality. Informed by the early findings of this research, VGH has implemented infusion pumps for transfusion of RBC units.

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