

Date: 3/12/2012

Title: Blood Sparing Procedure in Hematopoietic Stem Cell Transplant Patients via a Central Access Device

Clinical Question:

P (population) Hematopoietic stem cell transplant patients
I (intervention) blood sparing procedure using a closed system device via central venous device
C (comparison) versus standard lab draw procedure via a central venous device
O (outcome) impact need for transfusion and infection risk

Target Population:

Hematopoietic stem cell transplant (HSCT) patient population

Definition:

Blood sparing procedure: technique for returning wasted blood during laboratory draws using a closed system device via a central access device such as a central venous catheter (CVC), port, or peripheral inserted central catheter (PICC).

Recommendation:

There is insufficient evidence and a lack of consensus to make a recommendation on the use of blood sparing procedure in pediatric hematopoietic stem cell transplant patients via a central venous access device.

Note: Blood sparing procedure is an effective blood conservation method via arterial lines (Harber, Sosnowski, & Hegde, 2006[2b], Maclsaac, Presneill, Boyce, Byron, & Cades, 2003 [2b], Mukhopadhyay, et al., 2010 [4a], Tinmouth, McIntyre, & Fowler, 2008[4a], Thavendiranathan, Bagai, Ebidia, Detsky, & Choudhry, 2004[4b], Vincent, Baron, Reinhart, Gattinoni, Thijs, Webb, Meier-Hellmann, Nollet, & Peres-Bota, 2002[4b], Silver, Li, Gragg, Jurban, & Stoller, 1993[4b], Fowler & Berenson, 2003[5a]).

Note: Use of a closed system device with lab draws does not increase risk for blood stream infection via arterial lines (Peruzzi, Noskin, Moen, Yungbluth, Lichtenthal, & Shapiro, 1996 [3b]; Fowler & Berenson, 2003[5a]).

Discussion/Summary of Evidence Related to the Recommendation:

None of the articles directly answered our PICO question. Evidence does exist in other populations (i.e. adult intensive care, or hospitalized with a condition that would not contribute to anemia) using blood conservation methods to decrease the need for transfusions. Although the populations studied in the available evidence are not the same as the HSCT patient population, the similarities in condition and the phlebotomy needs are such that we feel able to generalize the results to this patient population. The literature indicates that using a blood sparing procedure, or returning wasted blood drawn during phlebotomy using a closed system via an arterial line, decreases the need for transfusions (Mukhopadhyay, et al., 2010[4a]; Tinmouth et al., 2008[4a], Thavendiranathan et al., 2004[4b]; Vincent et al., 2002[4b]). Thavendiranathan et al. 2004[4b]) found that for every 100 mLs of blood drawn with labs there was a 0.7 g/dL decrease in the hemoglobin ($P < .0001$) in acutely ill hospitalized adults without conditions that would contribute to anemia. Another study found a 48% reduction in packed red blood

cell (PRBC) transfusions in acutely ill adults with use of a closed system device for blood sampling via an arterial line (Mukhopadhyay et al., 2010[4a]).

Peruzzi et al. 1996[3b] found that using a closed sampling procedure does not increase the risk of blood stream infection via an arterial line. Some of the limitations of this study were the small sample size and short length of time the device was in use. Based on internal Cincinnati Children's Hospital Medical Center (CCHMC) blood stream infection data, collected 2008 to 2011 on patients weighing under 10 kilograms, using the blood sparing procedure does not put the patient at increased risk for blood stream infection (K. Demmel, email message with author, June 16, 2011).

Reference List:

Fowler, R. & Berenson, M. (2003) Blood conservation in the intensive care unit. *Critical Care Medicine*, 31(12), s715-720. [5a]

Harber, C., Sosnowski, K. & Hegde, R. (2006). Highly conservative phlebotomy in Adult Intensive Care- a prospective randomized controlled trial. *Anaesthesia Intensive Care*, 34, 434-437. [2b]

Lin, J. C., Strauss, R. G., Kulhavy, J. C., Johnson, K. J., Zimmerman, M. B., Cress, G. A., . . . Widness, J. A. (2000). Phlebotomy overdraw in the neonatal intensive care nursery. *Pediatrics*, 106(2), e19. [4b]

Maclsaac, C., Presneill, J., Boyce, C. & Cade, J. (2003). The influence of a blood conserving device on anaemia in intensive care patients. *Anaesthesia Intensive Care*, 31, 653-657. [2b]

Mukhopadhyay, A., Yip, H., Prabhuswamy, D., Chan, Y., Phua, J., Lim, T., & Leong, P. (2010). The use of a blood conservation device to reduce red blood cell transfusion requirements: a before and after study. *Critical Care*, 14(R7), 1-7. [4a]

Peruzzi, W., Noskin, G., Moen, S., Yungbluth, M., Lichtenthal, P., & Shapiro, B. (1996). Microbial contamination of blood conservation devices during routine use in the critical care setting: results of a prospective, randomized trial. *Critical Care Medicine*, 24(7), 1157-1162. [3b]

Silver, M., Li, Y., Gragg, L., Jurban, F., & Stoller, J. (1993). Reduction of blood loss from diagnostic sampling in critically ill patients using a blood-conserving arterial line system. *Chest*, 104, 1711-1715. [4b]

- Thavendiranathan, P., Bagai, A., Ebidia, A., Detsky, A. S., & Choudhry, N. K. (2005). Do blood tests cause anemia in hospitalized patients? the effect of diagnostic phlebotomy on hemoglobin and hematocrit levels. *Journal of General Internal Medicine*, 20(6), 520-524. [4b]
- Tinmouth, A. T., McIntyre, L. A., & Fowler, R. A. (2008). Blood conservation strategies to reduce the need for red blood cell transfusion in critically ill patients. *CMAJ: Canadian Medical Association Journal*, 178(1), 49-57. [4a]
- Vincent, J. L., Baron, J., Reinhart, K., Gattinoni, L., Thijs, L., Webb, A., . . . Peres-Bota, D. (2002). Anemia and blood transfusion in critically ill patients. *JAMA: Journal of the American Medical Association*, 288(12), 1499-1507. [4b]

Supporting Information

Background / Purpose of BEST Development:

Patients that receive high dose chemotherapy have a reduced ability to sustain production of red blood cells. Blood transfusions have many risks associated with them. Some potential side effects of blood transfusions include infection (bacterial, viral, parasitic, or prion), transfusion reactions, transfusion-related acute lung injury (TRALI), and transfusion-related circulatory overload (TACO) (Fowler & Berenson, 2003[5a]; Tinmouth et al. 2008[4a]; Vincent et al., 2002[4b]). Effective measures used to conserve hemoglobin/blood volume and, therefore, decrease the need for transfusions in relation to lab draws include: minimum blood volume phlebotomy (Tinmouth, McIntyre, & Fowler, 2008[4a]; Harber et al., 2006[2b]; Lin et al., 2000[4b]), decreased transfusion threshold to 7g/dL (Tinmouth et al., 2008[4a]), clustering blood draws (Harber et al., 2006[2b]; Tinmouth et al., 2008[4a]) and using blood sparing procedure with lab draws (closed blood sampling via arterial lines) (Mukhopadhyay et al., 2010[4a]; Harber et al., 2006[2b]; Fowler & Berenson, 2003[5a]; Tinmouth, et al. 2008[4a]; Thavendiranathan et al., 2004[4b]; Vincent et al., 2002[4b]; Silver et al., 1993[4b]).

This project was undertaken to look at a method of blood conservation using a closed blood sampling procedure via central access devices with laboratory draws in an effort to reduce the need for blood transfusions. Blood conservation methods currently in use at CCHMC are minimum lab volumes, batched lab samples, maximum daily blood volumes for lab draws based on patient weight, and hemoglobin transfusion threshold of 7 g/dL. The device is assembled at the bedside using clean technique and consists of a 3-way stopcock, an IV cap and a heparinized syringe. The blood sparing procedure is already in use with HSCT patients weighing less than 10 kilograms due to volume of blood needed for daily labs often exceeding maximum daily volume based on weight.

Blood sparing procedure via arterial lines reduces the need for blood transfusions (Maclsaac et al., 2003[2b]; Mukhopadhyay, et al., 2010[4a]; Tinmouth et al., 2008[4a], Thavendiranathan et al., 2004[4b]; Vincent et al., 2002[4b]). Although the populations studied in the available evidence are not the same as our patient population, the similarities in condition and the phlebotomy needs are such that we feel able to generalize the results to our patient population. Most HSCT patients within our institution have a central venous catheter (CVC) or larger lumen peripherally inserted central catheter (PICC) that requires 3mls or more of blood waste with lab draws. Current blood waste with lab draws average 27-30 ml per week per patient (with 7-10 lab draws per week and 3ml of blood waste). It is not unusual for patients to require lab draws multiple times a day and to exceed 30 mLs of waste per week. Arterial lines and central lines use the same technique for blood draws as central access devices and we feel able to generalize the results for the arterial line closed system devices to central access devices.

Applicability Issues:

The following materials required and current estimated total cost of the materials and services are:

- 3-way stop cock, heparinized syringe, and IV cap, estimated cost is \$1.50 (Thomas Long (operations coordinator for the Cancer and Blood Diseases Institute), email message with author, July 7, 2011).
- Estimated cost to administer PRBC is \$450 or more including tubing and filter (Ana Salguero (CCHMC transfusion specialist), email message with author, July 7, 2011).

Possible barriers to success include staff education, leadership support, and supply availability.

Outcome or Process Measures:

The outcome measures for implementing blood sparing procedure would be a decreased need for PRBC transfusions among the HSCT patient population. This outcome could be measured by monitoring PRBC transfusion rates pre and post implementation. Further process measures would include monitoring blood stream infection (BSI) rates to ensure the blood sparing procedures do not contribute to increased risk for BSIs.

Search Strategy:

A search of the literature was conducted by our unit level shared governance inquiry council from August 2010 to June 2011. The databases searched include: Ovid Medline, CINAHL, and Cochrane Library. A hand search was also conducted and questions were sent to the National Association of Children's Hospitals and Related Institutions (NACHRI) and Association of Pediatric Hematology Oncology Nurses (APHON) electronic mailing service. Search terms include: blood conservation, blood sparing, phlebotomy, transfusion, anemia, hematology oncology, pediatric, bone marrow transplant, critical care, blood management, blood wastage, and blood salvage. A filter of English language was applied.

Relevant CCHMC Evidence-Based Documents:

CCHMC Bone Marrow Transplant Procedure Blood Sparing Procedure 12.0

Group/Team Members:

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Conflicts of Interest were declared for each team member:

- No financial conflicts of interest were found.
- The following financial conflicts of interest were disclosed:

Note: Full tables of evidence grading system available in separate document:

- [Table of Evidence Levels of Individual Studies by Domain, Study Design, & Quality](#) (abbreviated table below)
- [Grading a Body of Evidence to Answer a Clinical Question](#)
- [Judging the Strength of a Recommendation](#) (abbreviated table below)

Table of Evidence Levels (see note above)

Quality level	Definition
1a [†] or 1b [†]	Systematic review, meta-analysis, or meta-synthesis of multiple studies
2a or 2b	Best study design for domain
3a or 3b	Fair study design for domain
4a or 4b	Weak study design for domain
5a or 5b	General review, expert opinion, case report, consensus report, or guideline
5	Local Consensus

†a = good quality study; b = lesser quality study

Table of Recommendation Strength (see note above)

Strength	Definition
It is strongly recommended that... It is strongly recommended that... not...	There is consensus that benefits clearly outweigh risks and burdens (or visa-versa for negative recommendations).
It is recommended that... It is recommended that... not...	There is consensus that benefits are closely balanced with risks and burdens.
There is insufficient evidence and a lack of consensus to make a recommendation...	

Dimensions for Judging the Strength of the Recommendation

Reflecting on your answers to the dimensions below and given that more answers to the left of the scales indicates support for a stronger recommendation, complete one of the sentences above to judge the strength of this recommendation. (Note that for negative recommendations, the left/right logic may be reversed for one or more dimensions.)

1. Grade of the Body of Evidence	<input type="checkbox"/> High	<input type="checkbox"/> Moderate	<input checked="" type="checkbox"/> Low
2. Safety / Harm (Side Effects and Risks)	<input checked="" type="checkbox"/> Minimal	<input type="checkbox"/> Moderate	<input type="checkbox"/> Serious
3. Health benefit to patient	<input type="checkbox"/> Significant	<input checked="" type="checkbox"/> Moderate	<input type="checkbox"/> Minimal
4. Burden on patient to adhere to recommendation	<input checked="" type="checkbox"/> Low	<input type="checkbox"/> Unable to determine	<input type="checkbox"/> High
5. Cost-effectiveness to healthcare system	<input checked="" type="checkbox"/> Cost-effective	<input type="checkbox"/> Inconclusive	<input type="checkbox"/> Not cost-effective
6. Directness of the evidence for this target population	<input type="checkbox"/> Directly relates	<input checked="" type="checkbox"/> Some concern of directness	<input type="checkbox"/> Indirectly relates
7. Impact on morbidity/mortality or quality of life	<input type="checkbox"/> High	<input checked="" type="checkbox"/> Medium	<input type="checkbox"/> Low

Comments on Dimensions (optional):

Blood sparing protocol provides minimal risk to the patient as a source of infection compared risk of exposure to red blood cell transfusions (Peruzzi et al., 1996[3b]). Some potential side effects of blood transfusions include infection (bacterial, viral, parasitic, or prion), transfusion reactions, transfusion-related acute lung injury (TRALI), and transfusion-related circulatory overload (TACO) (Fowler & Berenson, 2003[5a]; Timmouth et al., 2008[4a]; Vincent et al., 2002[4b]).

The estimated cost of the device is \$1.50 (Thomas Long (operations coordinator for the Cancer and Blood Diseases Institute) in email message with author, July 7, 2011).

The estimated cost to administer PRBC is \$450 or more including tubing and filter (Ana Salguero (CCHMC transfusion specialist) in email message with author, July 7, 2011).

Copies of this Best Evidence Statement (BEST) and related tools (if applicable, e.g., screening tools, algorithms, etc.) are available online and may be distributed by any organization for the global purpose of improving child health outcomes.

Website address: <http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/best.htm>

Examples of approved uses of the BEST include the following:

- copies may be provided to anyone involved in the organization’s process for developing and implementing evidence based care;
- hyperlinks to the CCHMC website may be placed on the organization’s website;
- the BEST may be adopted or adapted for use within the organization, provided that CCHMC receives appropriate attribution on all written or electronic documents; and
- copies may be provided to patients and the clinicians who manage their care.

Notification of CCHMC at EBDMinfo@cchmc.org for any BEST adopted, adapted, implemented, or hyperlinked by the organization is appreciated.

Please cite as: Cincinnati Children's Hospital Medical Center: Best Evidence Statement Blood sparing procedure in hematopoietic cell transplant patients, <http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/best.htm>, BEST 117, pages 1- 7, 3-12-12.

This Best Evidence Statement has been reviewed against quality criteria by 2 independent reviewers from the CCHMC Evidence Collaboration.

For more information about CCHMC Best Evidence Statements and the development process, contact the Evidence Collaboration at EBDMinfo@cchmc.org.

Note

This Best Evidence Statement addresses only key points of care for the target population; it is not intended to be a comprehensive practice guideline. These recommendations result from review of literature and practices current at the time of their formulation. This Best Evidence Statement does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the recommendations to meet the specific and unique requirements of individual patients. Adherence to this Statement is voluntary. The clinician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.