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Leukodepletion for Acute Lymphocytic Leukemia in a Three-Week-Old Infant

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We report the smallest infant (4.5 kg) to receive leukapheresis as an immediate treatment for Infantile Acute Lymphocytic Leukemia. Leukodepletion helps prevent the risks of hyperviscosity and cerebrovascular and pulmonary leukostasis. In addition, it is a desirable precursor to chemotherapy to potentially reduce metabolic and renal complications associated with rapid cell lysis. Because of this infant's small size, she presented us with multiple concerns, including hypocalcemia from citrate anticoagulation, extracorporeal volume and fluid balance, inlet flow rates. and establishment of adequate interface. Our positive experience in performing this procedure suggests that cytapheresis is a feasible treatment even for very young infants. J. Clin. Apheresis. 16:31-32, 2001.

Key words: leukodepletion; citrate; anticoagulation; COBE Spectra

INTRODUCTION

Therapeutic leukapheresis decreases the numbers of circulating white blood cells, which helps prevent leukostasis and hyperviscosity. As an adjunct to chemotherapy, leukapheresis potentially reduces the metabolic and renal complications associated with rapid cellular lysis [1]. However, experience with leukodepletion in infants, especially newborns, is limited. Thus, we detail our successful experience with a 3-week-old diagnosed with Infantile Acute Lymphocytic Leukemia, and how team effort gave this child a chance to live.

CASE REPORT

During a routine check-up, this three-week-old, 4.5kg, white female presented with a new erythematous rash on her back. A CBC drawn in the physician's office revealed a white blood cell count of greater than 100,000. The baby was sent to our emergency room and was admitted for work up of possible leukemia. Laboratory values included WBC, 567.9 K/mm^3; hematocrit, 38%; platelets, 70 K/mm^3; calcium, 11.3 mg/dl; potassium, 3.8 meq/ml; and sodium, 142 meq/ml. Over the next 12 hours, the WBC stayed in the 550s and the differential showed an absolute blast count of 562.2 or 99%. The attending hematologists requested leukodepletion to reduce risks of leukostasis and prepare the child for chemotherapy.

An immediate pre-apheresis blood count revealed WBC, 551.1 K/mm^3; hematocrit, 25%; platelets, 45 K/mm^3; potassium, 2.6 meq/ml; sodium, 137 meq/ml; and LDH, 2,020 IU/L.

One hour into leukodepletion, the patient's WBC had dropped to 251.3 K/mm^3, hematocrit was 30%; and platelet count was 22 K/mm^3. Immediately after the 2-hour procedure, the CBC showed WBC, 116.4 K/mm^3; hct., 24%; platelet count, and 22 K/mm^3. The ionized calcium was 1.22; potassium, 2.5; and sodium, 139. Fluid balance was maintained at plus 2 ml. Chemotherapy was initiated. One week post leukapheresis, the infant was doing well and has an excellent prognosis for recovery.

DISCUSSION

Having never performed apheresis on a baby younger than 9 months, our staff had serious reservations about potential risks of the procedure. Initially, it was felt that exchange transfusion might be a safer and similarly effective treatment. When the physicians ruled out this option, the child was sent to the operating room for dialysis catheter placement.

Obtaining adequate venous access became the first obstacle. Attempts by the surgeons to place femoral lines proved unsuccessful. With due consideration to the risks and benefits, the neonatology staff decided to paralyze, intubate, and anesthetize the baby to allow for placement of a larger catheter.

Meanwhile, the apheresis staff brainstormed, discussing all potential problems and resolutions. This infant, at 4.5 kg and 53cm, had a total blood volume of approxi-

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mately 400 ml. The extracorporeal volume of our COBE Spectra WBC kit is 284 ml not inclusive of the blood warmer. We knew our standard RBC prime would essentially add a 70% hematocrit product to this child's already viscous blood. Therefore, we opted for leukocyte-reduced, irradiated whole blood, reconstituted from RBCs and FFP, with a hematocrit of 40%.

Depleting the child's platelets was a potential problem, not only due to the blood prime but also by virtue of the procedure itself, which removes some platelets in the buffy coat layer. We decided to run a CBCPD during the procedure and have platelets ready for transfusion.

Citrate toxicity was a major risk since a fairly large volume of ACD-A is infused in the course of a leukocyte procedure. We have witnessed dramatic drops in ionized calcium levels of even larger children during white cell collections. As part of our SOP, we routinely measure ionized calcium levels every 30–45 minutes throughout pediatric apheresis and titrate a calcium gluconate drip to maintain the ionized calcium at 1.0–1.3. However, because of the child's very small blood volume, we asked for assistance from the hemodialysis team to systemically heparinize the infant, thus, avoiding the use of citrate and negating the potential for hypocalcemia.

We then began to address fluid replacement concerns. During aggressive leukodepletion, we maintained isovolemia by replacing volume with 5% Albumin. The COBE-BCT technical staff, with whom we had consulted, suggested that we utilize the anticoagulant line for milliliter per milliliter albumin replacement.

We questioned the ability of our COBE Spectra Apheresis machine to maintain an adequate interface with the indicated slow inlet rate, small total blood volume, and comparatively large extracorporeal circuit. Would the dwell time be adequate to develop a white cell layer large enough to allow for depletion? We were assured by COBE, that a successful peripheral stem cell collection had been performed on a 5.5 kg infant.

Finally, we requested the support of the neonatal intensive care staff and the presence of the attending pediatricians during the procedure, in case we did encounter difficulties.

THE PROCEDURE

The therapeutic leukapheresis was performed in the neonatal intensive care unit with the hematology, nephrology, and neonatal physicians, the nurse practitioner, dialysis and NICU nurses, and two apheresis nurses present. The infant remained paralyzed, intubated, and was receiving ventilatory support.

With heparin infusion started, the dialysis nurse measured activated clotting times, and gave additional heparin to achieve systemic anticoagulation. The COBE Spectra was primed with the reconstituted whole blood and an extra 100 ml was processed to begin cell separation. An 8 fr Quinton catheter in the right internal jugular vein provided stable access. We connected our separator to this line at completion of the blood prime.

A buffy coat was visible within minutes, and we immediately began adjusting the plasma pump rate. We changed the patient data entry, increasing the patient's height and weight, which allowed us to modify the inlet rate to 10 ml/minute, as recommended by COBE. Switching into manual mode, we were able to match our albumin replacement rate through the anticoagulant pump, with the 2 ml/minute collect pump rate. The targeted inlet volume was increased to accommodate the blood prime amount. Minor plasma pump adjustments were needed to maintain a stable interface and achieve a desirable collection.

Halfway through the depletion, we again increased our targeted time to collect for approximately 2 hours. This allowed the dialysis nurse to begin tapering the heparin dose and decrease the activated clotting time.

When the leukapheresis was complete, we disconnected our lines, flushed the baby's catheter, and discarded the blood filled apheresis tubing.

CONCLUSION

Leukapheresis can be safely performed on even the smallest children with forethought, planning, and a multidisciplinary effort.

CONDITION UPDATE

While having battled complications from various treatments, this 10-month-old infant has undergone successful allogeneic bone marrow transplant and presently is home with her family.

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