

Leukopheresis: Breaking Barriers A Case Study

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SickKids[®]

Objectives

- Understanding of a Leukopheresis
- Gain knowledge on how a Leukopheresis is performed at Sickkids
- Gain understanding of unique circumstances with this case study
- Identified lessons learned



Definition of Leukopheresis

- Leukopheresis is a procedure which involves the separation and removal of excessive mononuclear cells (MNC) from the blood, of patients with acute myelogenous leukemia, acute lymphoblastic leukemia and chronic lymphocytic leukemia with symptomatic leukocytosis ($WBC > 100 \times 10^9/L$)
- This is done using a cell separator device, the red blood cells, platelets, plasma and remaining white blood cells are returned to the patient along with a prescribed replacement fluid.



Goals of Leukopheresis

- Rapid removal of a greatly elevated WBC
- Reduce the morbidity and/or mortality of the patient
- Decrease the viscosity of the patient's blood
- Reduce the WBC load to start chemotherapy rapidly after treatment



Case Study Information

- Age of patient: 3 months old
- Weight: 5.2 Kg
- At the cottage for the week
- Two day history of cold like symptoms
- Became very pale in color the morning of the day of diagnosis
- Youngest of two children (2 year old sister)
- No family history of cancer
- Mother was a social worker at the hospital in the ICU



Preparing for the Leukopheresis

- Getting orders from Haematology
- Signed Consent
- Ordering Blood Prime and Blood Products for replacement
- Getting a bed in ICU ASAP
- Getting a femoral line in, in a timely manner
- Preparing the machine and equipment



Bloodwork Results Pre Treatment

Patient Results

- WBC Count: 1047 X 10⁹/L
- Platelet Count: 10 x 10⁹/L
- Haemoglobin: 46 g/L
- HCT: 13%
- Potassium: 2.9 mmol/L
- Ionized Calcium: 1.17
- Magnesium: 1.19 mmol/L
- Phosphate: 1.40 mmol/L

Healthy Child Results

- WBC Count: 5-12 x 10⁹/L
- Platelets: 150-400 x 10¹²/L
- Haemoglobin: 110-140 g/L
- HCT: 27-42%
- Potassium: 3-5 mmol/L
- Ionized Calcium: 1.22-1.37 mmol/L
- Magnesium: .70-.95 mmol/L
- Phosphate: 1.16-2.1 mmol/L



What To Do With These Results?

- The weight and age of the child alone was a concern
- High WBC and Inlet Volume that did not fit the Qcoll chart
- Hyper viscosity of the blood
- Risk of bleeding due to low platelets
- What HCT do you pick for blood prime?
- Hypovolemia post treatment due to the shift of viscous white cells was a possibility
- Patient was deteriorating rapidly
- Urgency to deplete cells from ICU staff was becoming stressful on ICU and Apheresis nurse



Calculating the Replacement Solution

- Calculating TBV: weight x 80 mLs/kg
- TBV= 416 mls
- 10% extracorporeal allowance: 41 mls
- WBC tubing and warmer= >300 mls
- Order Reconstituted Whole Blood= 325mls with HCT of ?
- Inlet volume to be processed is 2 x TBV= 832 mls
- Divide the blood processed by the speed of the treatment= $832 / 15 = 55$ min tx
- Collect pump flow rate (Q_{coll})= WBC 800, inlet speed=15 mls/min, $Q_{coll}=7$ mls/min
- Find replacement volume=collect pump flow rate x time $7\text{mls/min} \times 55\text{min} = 385$ mls



Patient Assessment

- Patient in ICU from Emergency in less than 4 hours
- Femoral line inserted- 6 Fr Gamcath
- Patient vented and sedated
- A unit each of Fresh Frozen Plasma and Platelets given prior to femoral line insertion
- Hydration started
- Bleeding heavily from the femoral site.
- Vital signs: Temperature- 36.5 Ax, Pulse 147, BP 100/56, O2 Sats 100%
- Patient had good urine output



Treatment

- Benadryl pre treatment
- Blood prime done and no reaction
- Repeat CBC and electrolytes completed at start of treatment
- Line functioned well at start of treatment
- Went into Quick Start
- ACD ratio set at 12:1
- Approximately 20 minutes into treatment, began to have access problems and had to flush, reverse lines and reposition the patient
- It was noted at this time the lines were “white” with cells

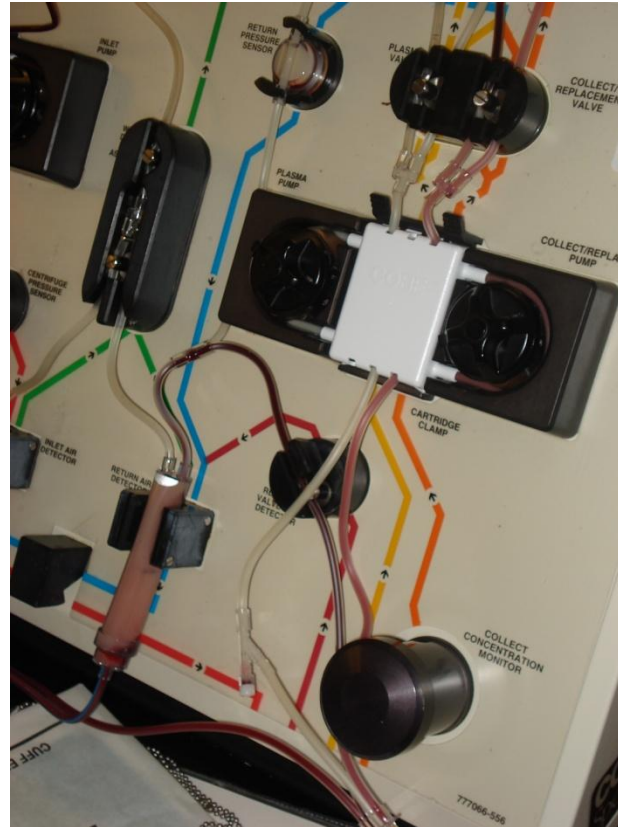


Treatment

- Still in Quick Start at 48 minutes and 800 mls processed, came out of Quick Start manually
- Set Qcoll at 7 mls/min
- Red cells from the prime and patient's blood began to migrate up into the waste bag
- After 15-20min and the red cells still migrating into waste bag, changed plasma pump and Qcoll to 10 mls/min
- After this change, white cells migrated into bag and red cells returned to the patient within minutes
- Color on the color gram matched 2% with the change
- Bloodwork done half way through showed the potassium dropped to 2.6 mmol/L and Ica .90 mmol/L
- Potassium increased in the infusion and increased Calcium Gluconate infusion from 5ml/L to 7.5 ml/L



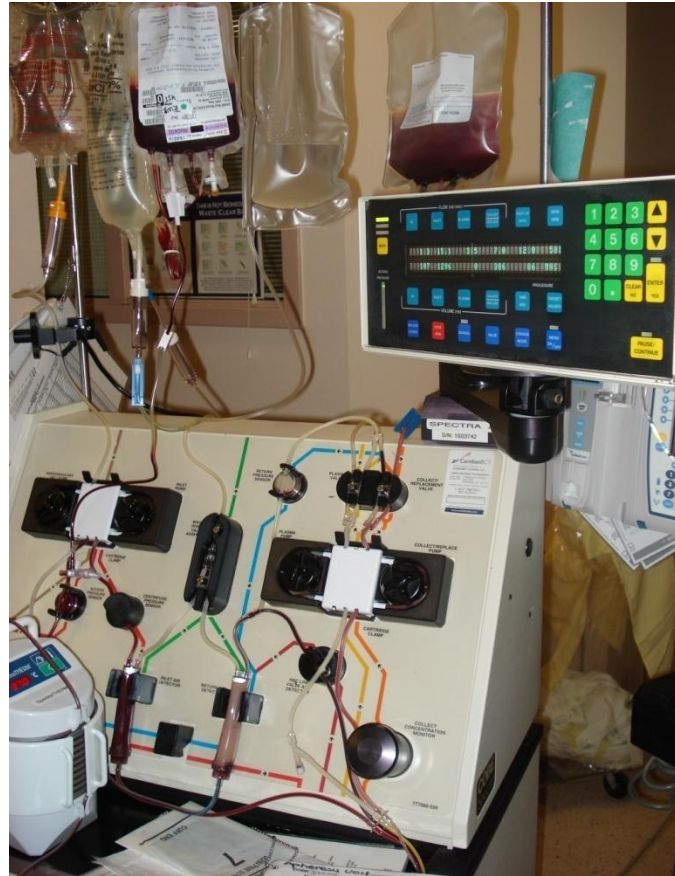
Leukopheresis



Leukopheresis



Leukopheresis



Post Results

- Run Time 107 minutes (added volume processed for time in Quick Start)
- Citrate used 133 mls
- Inlet volume processed 1603 mls
- Collected 529 mls of cells (red and white)
- AC ratio 12:1
- When Qcoll increased to find color, 529 mls of cells removed instead of 385 mls
- When blood product was released to patient, it was noted that more product when ordered



Post Results

- 300 mls of plasma given first followed by 300 mls of platelets
- Fluid balance post replacement fluids and cells removed left the patient positive 220 mls plus one wet diaper
- Vital Signs post: Temperature 36.3 Ax, Pulse 142, BP 90/50 and O2 Sats 100%
- Blood work results: K+2.2, Ica mmol/L, 0.75 mmol/L and WBC $356 \times 10^9/L$ (70% depletion in cells- approximately 3.7 L processed), HB $29 \times 10^9/L$, HCT 9%, Platelets $63 \times 10^{12}/L$
- Samples sent from waste bag for genetic testing
- Therapeutic drugs commenced immediately post treatment
- Treatment did not have to be repeated



What Was Learned

- Small size patient's with high white counts can be successfully depleted
- Fine tuning numbers and using clinical judgement to make changes can lead to success
- If the volume to be processed was not increased, the treatment would have to be repeated, causing a delay in therapeutic treatment and possibly further rapid deterioration of the patient

